Bit Bang 9:
Entrepreneurship

Yrjö Neuvo, Erkki Ormala & Meri Kuikka (eds.)

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Aalto University

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Foreword

This book is the 9th in the Bit Bang series of books produced as multidisciplinary teamwork exercises by doctoral students participating in the course Bit Bang 9: Entrepreneurship at Aalto University. The course was facilitated by Professor, Research Director and former Nokia Chief Technology Officer **Yrjö Neuvo**; and Professor **Erkki Ormala**, former Vice President of Nokia. 23 students took part in the course during the academic year 2016–2017. The students were selected from diverse academic and cultural backgrounds: 12 nationalities were represented by students from all six Aalto Schools, leading to spirited in-class discussions and multidisciplinary teamwork.

The learning objectives of the course centered on teamwork, multidisciplinary collaboration, and gaining global perspectives and foresight on the future of entrepreneurship. These were achieved through weekly lectures from visiting industry leaders, writing the chapters of this book, and other teamwork assignments. As textbook material and to support class discussions and teamwork the students used *Enterprise and Small Business: Principles, Practice and Policy* by **Sara Carter**, as well as selected chapters from previous Bit Bang publications.

Working in teams, the students set out to explore questions related to entrepreneurship. The course approached the topic of entrepreneurship from various angles, including working effectively with other people, identifying your business case, managing your business effectively and what makes entrepreneurs successful. By the end of the autumn term, four teams had produced four points of view on the effects of digitalization published in this book: *Back to the soil: opportunities to enhance the urban food industry; Overtaking an Industsry on the Verge of an Unforeseen Technological Disruption; Changing Hats: From Academics to Entrepreneurs;* and *From Earth to Cloud: Relevance of Location in Digital Platform Economy.*

At the start of the spring term, the groups were reshuffled and set to tackle new topics: *Can Social Enterprises Be Born Global?; Entrepreneurship and the Good Life: An Autoethnographical Study of the Question, "Why Not Be an Entrepreneur?"; Pay It Forward: Circular Economy Approach* and *Trash2Cash: The Era of Augmented Intelligence.*

During the spring term, the course also visited New York and Boston for a

week-long study tour. The tour program and short reports on the company and institution visits are available in the appendices of this book. The unique nature of the course has generated lots of positive feedback from the academic community, and produced an extensive network of alumni connecting doctoral students and graduated doctors. We are very proud of the community we have been able to gather around this unique and though-provoking course.

We wish to give our special thanks to this year's tutors and Bit Bang alumni **Gautam Raj Moktan, Abdollah Noorizadeh, Jussi Nykänen** and **Tania Rodriguez** for their tireless work with their teams and valuable advice given whenever needed. We also wish to thank our esteemed guest lecturers representing government, industry and academia. Their presentations and discussions gave valuable insight into the issues studied, and their role was essential for the success of the course.

We wish you captivating moments with the book!

Yrjö Neuvo, Erkki Ormala and Meri Kuikka

Entrepreneurship

Back to the Soil: Opportunities to Enhance the Urban Food Industry

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ABSTRACT. *Through this issue paper, we discuss the current state of urban food production, reasons behind the increased attention this field of activity has engendered worldwide, and some of the larger movements underpinning the whole concept. More specifically, our inquiry originates in questions surrounding both the technological and societal factors coming to bear on this small, yet growing movement. Asking, "In which ways might technology enable entrepreneurial opportunities in the field of urban food production and distribution?" reveals a landscape full of potential. As well, we introduce science-fiction prototyping as a means to discuss potential futures related to food production. Touching on sociological, as well as technological and economic underpinnings, this study leads us towards a proposal that is platform-based, inclusive, open-sourced, and ambiguous. On a personal level, we hope to develop and support the emerging niche of urban food producers, with technology, through a process of entrepreneurial discovery and creation.*

KEYWORDS: *urban farming, ecopreneur, CarrotBnB, rooftop production*

1 Introduction

A brief history of human settlement since the Neolithic Revolution (~10,000 B.C.), that time when nomadic tribes began to settle down and raise crops, leads us to accept that communities grew their food where they lived. As cities grew, the demand for food grew well beyond what could be produced in the near surroundings. In time, transportation and subsequent industrialisation permitted the use of far-off lands (and their peoples) to support dense urban settlement with sufficient food supplies and resources. As awareness of our ecological footprint – that effect we humans have on the environment – and a certain knowledge of food scarcity or availability has grown, we find some communities and individuals seeking ways to reduce their dependence on long logistics chains, exploitive growing practices, and industrialized food production. Many of these people are turning to urban farming.

This issue paper starts by analyzing the current issues and technological state of affairs in urban farming, in search of new opportunities for entrepreneurship. It then focuses on rooftop food production as an example of what is currently possible and scaleable – in Finland and elsewhere. We propose a fictional service-based platform to combine current trends with future bricolage solutions to expand and strengthen urban farming. We conclude by discussing both the short-term and long-term possibilities such a platform could provide in terms of entrepreneurial activities in urban food production.

Before turning to our present day, state of the art in urban food production, we also want to propose science-fiction prototyping (SFP) as a method for discussing future applications of technology and the social impacts lying dormant in technological change (Bell et al 2013; Love 2001; Johnson 2009; Johnson 2011). Our first example of SFP follows, and will be discussed later, as an example of what may come to be. These fictional texts of the future are inserted into this issue paper to push the time horizon out as far as 200 years into the future. While urban food production can be a part of both utopian and dystopian futures, our desire to point to social issues arising from and giving rise to, this important activity.

Ville and Petra

Petra was leaning her head against the cupboard above the sink, her legs shoulder-width apart, her left hand covering her left ear, and her right hand covering her right ear. She said the words "Surprise me!" out loud and slowly, zucchini pasta formed in the food printer. She waited for her son, Ville, to breathe in, turned to where he sat in his high chair surrounded by plates of spaghetti, fish sticks, salad,

hot dogs, French fries, and other "kid-friendly" food. None of it touched while he screamed, "Nah! No! Nah!" over and over at full volume. Below him rested a small pile of plates and food that he had touched – just to sweep off the table. She had given up trying to please him with her cooking, which involved choosing from over 1275 different meal recipes and then selecting, "Print". Now, as his crying had continued for more than 18 minutes, she hoped the machine would surprise her, and him, with a food he'd accept to eat. It didn't. Ville immediately threw it on the floor, where it bounced and left a bit of cheese and white sauce on the wall.

It wasn't always like this, she reminisced. They used to live in the city and have to buy bulk proteins and carbohydrates themselves, confirm a delivery time, and then load the cartridges into their home food printer. They were students then. Now, far out beyond the ring road, in a small town that had been built on a theme of 1920's America, their food supplies came via pipes much like their water had back in the 2020's. The raw material of their food went into two separate tanks and was used to make everything from steaks to lobster to milk to carrots.

"Carrots!" she yelled at the machine, just as the zucchini lasagne came to its final resting place beside a chicken and rice casserole. "Carrots!" she repeated. The machine hummed a bit and Ville went silent, watching as the long orange carrots took form under thse printer's nozzles.

"Behe!" he pointed at the machine. And then it whistled to signal "Print complete".

Completely drained, she quietly shrugged and handed him 4 large carrots, "Carrots?! Behe means carrots?"

With a big smile, he grabbed the nearest carrot, snapped the end off with his few teeth, and laughed, "Behe!"

Petra slowly collapsed against the cupboards, slid down to the floor and wept quietly to herself, while collecting zucchini and chicken bits from under Ville's chair.

2 Why urban farming?

When looking at global megatrends three factors stand out: population growth, urbanization and climate change. These factors all put pressure on space and resource utilization, especially in the context of food production. The sustainability of traditional, industrial farming and food supply is being questioned both by those who foresee a utopia of positive changes through technology, and those who fear a dystopian future.

In terms of basic requirements for survival, people need water and food – neither of which is infinitely available (with current technologies). Add to this a

growing population and one understands the critical position mankind currently inhabits. It is predicted that by the year 2050, there will be 9 billion people on the planet and more and more of them are moving to cities (see Figure 1). It has been estimated that global urbanisation could reach 70% by 2050 (UN, 2008). Urban population growth in Finland was almost 3% between 2000 and 2005; and currently 84% of the total population of 5.3 million live in urban settings (Niemelä et al., 2010). Keeping in mind that towns and cities were often established around fertile land, and more land will be required to handle the increased urban populations, we see that arable land is being constrained. Some research suggests that, based on population growth rate estimates, the world will need 1 billion hectares more arable land to feed itself (Despommier 2010).

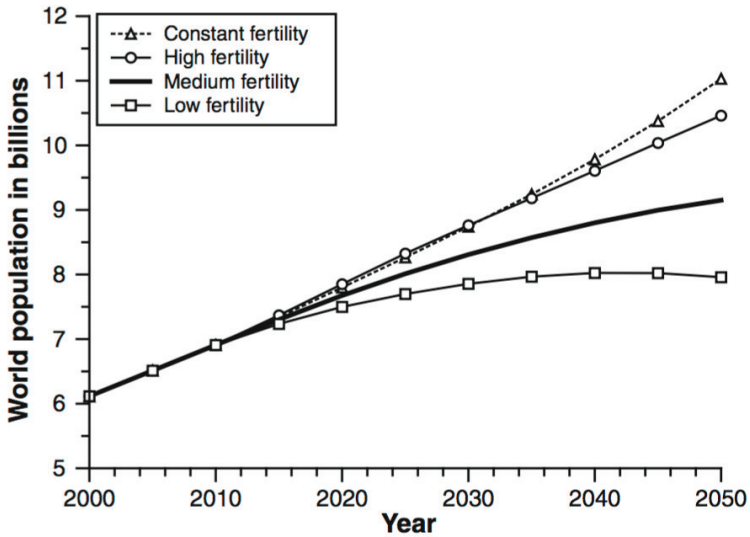

Fig. 1. *Population of the world, 2000-2050, by UN projection variants [data source: United Nation Population Division (UNPP 2009)]*

Prioritizing economic growth over sustainable practices has led to a number of negative effects on the environment and societies in the past few decades. Rapid climate change is a result of human, non-sustainable intervention and development. This is a process wherein the effects are already visible and are leading to catastrophic phenomena, especially from the point of view of food security. Droughts and floods, are jeopardizing existing farmlands and ecosystems, with roll-on effects on the economic and social health of peoples (Aubry, et.al. 2012).

A quick illustration of our situation: Rice, the primary food source for a majority of people today, utilizes inordinate amounts of land and water. Bouman et al. (2007) noted that as much as 30% of the water used by humans is for the

irrigation of rice. Currently, rice production is conducted in aeroponic systems (flooded, open air environments) and is a resource-demanding crop in terms of light intensity, water and nutrient requirements, management of temperature, etc. (Germer et al., 2011). Challenges that rice crops encounter are abiotic (temperature, light, humidity) or biotic stress (fungi, bacteria, viruses, insects). Due to the volume of resources involved and the enormous amount of end product, one can conclude that innovative rice cultivation systems have a high impact factor, in terms of ancillary effects, than innovations in other areas of food production. In simple terms, a small change in this field yields substantial results.

The question of "How to feed the world's population, now and in the future?" is one of the biggest challenges humanity is facing. As cities rely almost entirely on external resources to support existing populations, continued urban growth can lead to food shortages and put the health and wellbeing of citizens at risk. This raises questions about food security and self-reliance in cities. Local food production is a timely topic which could ease cities' dependence on external sources for provisions, alleviate urban poverty and nutrition problems, as well as reduce cities' ecological footprint (Mougeut 2006). Urban farming can offer some solutions to the challenge of supplying food to urban centres, by utilizing the urban space as a platform for plant cultivation. At the same time, it can bring a number of other benefits to the urban environment and urban dwellers.

Urban Agriculture is defined as comprising primary and/or secondary agriculture. In this definition, primary agriculture refers to land uses that are primarily focussed on the activity of agriculture, whereas secondary agriculture comprises all land uses that integrate agricultural activities as an add-on to their primary land use. This could include vertical farming, rooftop gardens on residential or commercial buildings, and window sill and house gardens (Giseke et al., 2015, pp.34).

As Doron (2005) noted, horticulture is scaleable from window boxes, to balconies and roof-top gardens, etc. Since land in the urban environment is limited and expensive, such spaces could potentially provide space for agriculture to alleviate space-related issues (Whittinghill & Rowe 2011). This is being explored in highly populated cities including New York, Toronto, Berlin, Tokyo and Hong Kong, to name a few (Doron 2005). For our part, the question that begs asking is, "What are the opportunities for entrepreneurs in the urban food industry, now and in the future?"

3 Urban farming as it exists now

There are promising possibilities for the future of urban food production, both indoors and outdoors. Today, indoor food production (e.g. windowsills) as a part of the urban agriculture movement is gaining attention (Tracey, 2011). However such places are mainly used to grow small amounts of fresh vegetables, herbs, fruits or sprouts. Also, vertical gardening (skyfarming) has brought new opportunities for food production in urban areas.

In addition to indoor spaces, outdoor or open-air green roofs also create various benefits, such as an increased lifespan of the roof, energy savings due to increased thermal insulation and cooling, improved stormwater management, better air-quality and sound insulation. In addition, aesthetics, wellbeing and improved biodiversity arise from such practices. Studies show that green roofs double the lifespan of the roofing membrane to about 40 or 50 years, (Oberndorfer et al., 2007). In addition to these outcomes, green roofs can be used for food production. This has been shown to contribute to economic development, educational enhancement, job creation, food security and community building benefits to urban dwellers (Whittinghill, L. and Rowe, D.B. 2012). In recent years, green roofs in Finland have become popular, however, they have not been used for food production. An experimental study by Pervilä et al. (2012) illustrated the result of a one-year prototype rooftop greenhouse in Helsinki, Finland. The greenhouse was heated by exhaust heat harvested from a rack of computer servers while the servers were only cooled by unconditioned outside air. They produced several edible plants such as tomatoes and chili peppers which then was used in the local university cafeterias as seasoning. Student volunteers continued to operate the greenhouse with the intention of selling the chili peppers to benefit their student association. The result of this experimental study indicated that rooftop greenhouses using harvested exhaust heat could be a feasible solution for urban food production. Agricultural activities in Helsinki, Finland occur in diverse micro-environments: one's own yard, balcony, colony gardens, and allotments. Colony gardens or allotments with/without small cottages originated from the beginning of the 20th century and were a traditional setting for growing food just outside the city centre. Nowadays these colony gardens are squeezed between the housing areas, as urbanization has led to a larger metropolitan region. Usually owned and managed by the municipality, people rent small plots, cultivating and maintaining the land. Since these colony gardens and allotments are limited, citizens have started initiating their own gardening projects (Luokkala, Rosaleena, 2014). The environmental organisation Dodo (http://kaupunkiviljely.fi/brief-in-english/)

with the motto “Environmental problems are solved in the cities”, has helped and inspired people to undertake urban farming.

The organization, Dodo, has two urban gardens in the Helsinki area: Kääntöpöytä and Kalasatama. Kääntöpöytä is a cafe, greenhouse and an open, public space situated in Pasila´s historic railway yard. In 2012, part of the yards were developed into an urban farming test lab and a place to learn and inspire. They also provide workshops, gatherings, organic brunches, chances to learn about organic, urban farming and the encouragement to take the “seed of growth to your neighbourhood”. In Kalasatama Bag Garden, which is a collaborative programme with the city of Helsinki, gardening originates in big construction bags that are filled with soil, rented from Dodo, which also provides the space and management of the space. In addition to these movements, both Aalto University and the University of Helsinki are contributing to urban farming. Aalto provides small plots to students and staff while the University of Helsinki is conducting research on green roofs in a project called The Fifth Dimension. This program facilitates research on the benefits of green roofs and establishes test roofs around the country in order to find sustainable green roof solutions that are best suited to Finnish conditions (Luokkala, Rosaleena, 2014). One concrete example is the food grown on the rooftop of an old cable factory, which then goes directly to dishes prepared by Restaurant Savoy, within the same building complex. We explore the link between restaurants and roof-tops further below.

3.1 Restaurants

At the University of Applied Sciences of Tampere a pilot project has been organized for local restaurants in an effort to develop urban farming practices by themselves (Kivireki). As a result of the project different stakeholders have noticed that there is potential in urban farming as yields have been greater than expected. However in the workshop discussions local entrepreneurs and restaurant owners highlighted the lack of a network for producers, customers and related services. The pilot project revealed a need for easier sharing of practical knowledge about urban farming amongst stakeholders. Also they felt that urban farming should be incorporated sooner in the planning and building design process, as existing regulations and legislation concerning urban farming are setting barriers for practical farming work. We felt that it was important to hear the voice of a restaurateur in regards to urban farming and food services.

3.1.1 Restaurant interview

Juuri Ravintola, a restaurant in the downtown core of Helsinki, Finland, has a philosophy that guides their work - they want to use the best products they can find, and they would like to source from Finland. With 12 years of experience, they are known for their organic and locally-grown ingredients which they source from a professional organic farmer in Helsinki, who is farming 10,000kg of vegetables and herbs exclusively for their 7 restaurants. With over 1,200 customers per day, it is not possible to rely solely on one supplier unfortunately, and this leads to several obstacles. For example, they have to pay from 30 to 35 Euros for organic asparagus, which lowers their financial returns. The other choice would be to source non-organic – it is a balancing act between great organic food and a price customers are willing to pay. The goal is to gain people's trust by always informing them about the quality of their products and in this way build a brand. Another goal is to make people understand the benefits of purchasing local products, where the word "products" does not refer only to food, but to services and products alike. Juuri Ravintola's owners hope that local Finnish restaurant goers would be more aware of what is in season in Finland, a country rich in berries and mushrooms, and ask restaurants to offer these more often, supporting local growers and distributers. Juuri's representative reflected on the past 10 years and found that the progress was slower than expected in urban farming, creating a certain degree of scepticism about the next 10 years.

3.2 Green roofs interview

In 2013, Juhamatti Niemikapee started research on a green roof, built in 2006. His research concentrates on moss roofs, particularly on which species can colonize ultra light substrate (thin soil environments). His research involves 8 structures divided into 3 depths (1, 2 and 4 cm) composing a total of 240 sample areas. Due to changes in Helsinki city's own strategy (Stadin katot elävät, 2016), now promoting green roofs and encouraging builders and designers to consider this as a viable alternative, Juhamatti sees a better future. However, he does also point to some obstacles. In terms of food production, the weight of very thick substrate combined with Finland's winter snows, is simply too much for many existing structures.

Nonetheless, new and existing buildings can provide benefits to both the local community and the environment such as: storm water control, biodiversity, insulation and the possibility of growing food. It can even be a place where people would want to go and be in nature in the middle of the city, a place to relax. In terms of maintenance, a green roof built with certain moss types would require no attention

or work after getting established. More intensive types of green roofs would require an equivalent intensity of work, naturally, to produce food or park-like settings.

3.3 Megacities and Urban Farming

In 2011 it was estimated that there were at least 700 farms and gardens that grew food in New York City (Cohen, N. et al., 2012). In 2014, GreenThumb, a community gardening program, registered its 586th garden (The City of New York, 2014) while in the same year, 45 new community gardens were constructed on New York City Housing Authority sites and 70 more were projected for 2015. To cater to the growing demand and interest, the New York Department of Parks and Recreation established five farmers' markets at community garden sites (The City of New York, 2015). In a survey dated 2015 (Manhattan Borough President's Office, 2015), 58% of the gardens surveyed had been established within the past five years, and 26% had been started within the past year. The survey stated that 24% of gardening programs featured a hydroponic (soilless growing) system or were on a rooftop, 20% had a rooftop greenhouse and the rest were traditional outdoor gardens. In 2016, New York City had more than 900 gardens and farms (Adler, T., 2016).

Space-starved Hong Kong can only produce 2% of its fruit and vegetables locally (Hakes, C., 2016). However the city, with its vast empty rooftops and high-rise walls, has taken an interest in urban farming, which could transform organic fruit from a rarity to commonplace. From 2012 to 2015, Hong Kong completed more than 50 roof-greening projects in government-owned buildings and schools, with another 25 projects underway in 2015 (Lim., R., 2015). That same year, City Farm, an urban farming organization, had about 100 regular gardeners, two years after opening and estimates suggest there are more than 300 such locations (Lim., R., 2015, Wyss, R.). The city is also growing new species in order to promote leisure farming, of which strawberry picking was very popular in the late 2000's. In 2013, out of the 120 registered leisure farms, approximately 80% of them provide self-picking services (Lau, 2013).

With a population of five million crammed on a tiny landmass of just 715 km2, Singapore has been forced to expand upwards. The scarcity of land leaves the agricultural production insufficient to supply the needs of its residents, and as such, about 90% of the country's food comes from overseas imports. However, over the course of three years, more than 80 plots with fruits, herbs and vegetables have sprung up across the city, burnishing Singapore's reputation as a garden city (Wilson, K., 2016). The reason could be the city's interest in vertical farming — not only in greenhouses in the vanishing countryside but also on rooftops in the heart of the city, amid soaring skyscrapers and housing blocks. Sky Greens, one

of the world's first commercial vertical farms established in the city grows crops in greenhouses on 30-foot-high vertical frames with hydraulic rotating troughs that bring the plants down to water and then up to the sun. The farm spans almost 9 acres with a production of 3,000 tons of vegetables per year (Pao, M., 2014). Comcrop is another such start-up, which is producing crops in vertical racks that draw water and nutrients from fish waste in water tanks. According to them, the yield is 8 to 10 times more than traditional land-based farming through the creation of self-sustaining aquaponics system. Their first successful farm was built on a shopping mall roof, nearly the size of two basketball courts, producing about 60 kg of food a week. They are planning to establish a farm 10 times larger, which would produce 23 tonnes of food per month (Ee, J., 2015).

Although Australian cities do not share the issues of urban density that have made the practice of urban farming so popular in New York, Hong Kong and Singapore, indoor or urban growing techniques still find a market in Sydney. The principal reason could be the reduction in agricultural land, e.g., there has been a drop of 15% in the number of Sydney farms and a 20% loss of arable land in just two years between 2006 and 2008 (James, P. et al., 2010). Moreover the city has the capability to produce high-quality leafy stock on demand, and the city has already invested efforts in this direction; Sydney had 49 green roofs across the territory in 2012 (Gora, B. 2012), and allocated 100,000 square meters to green roofs for 2015 (The Natural Blaze team, 2015). According to the Directory (Australia city farms & community: directory, data and mapping), there are at least 65 community gardens in Sydney and surrounding municipalities, as local councils list 22 community gardens in the city (City of Sydney). This discrepancy is perhaps due to different labels, but nonetheless there is clear growth in this sector. Examples of rooftop gardens can be seen in Figure 2.

Fig. 2. *(a) Brooklyn Grange, a 2.5-acre organic urban rooftop farm in New York City (Brooklyn Grange Farm). (b) A rooftop farm in Hong Kong (Gogreenhk, 2014). (c) A vertical farm by Comcrop in Singapore (Ee J., 2015). (d) A rooftop farm at QT Sydney Hotel in Sydney (Hoh, A., 2016).*

Here, we take another break from today to discuss via SFP, roof-tops, buildings and greenhouses and how they may need to be retrofitted to accommodate changes in society.

Andrea and Jurgen

Andrea was a big person by anyone's standards – 2.10 metres tall, 115 kilograms, and she was never questioned with, "Haven't we met before?" Unforgettably tall. As a building inspector, she garnered respect from construction workers and project managers alike. Everyone liked her, if they tried to run a decent refit business. Those who cut corners prayed Andrea's enormous shadow would not come anywhere near their sites. Jurgen, one of many site supervisors who ran a clean business, was happy to see Andrea's transport in the distance.

In the late 2110's, a half century after the Caza Virus had taken so many lives, retrofitting buildings in what had been Germany and France was the place to be in construction. So much free space with more than 70% of the population gone – everyone could have their dream apartment or house as long as you could offer some service in return for a place. Energy and tech were abundant and cheap, so there was little use for currencies. Barter was the norm, even in government.

Nano technology had progressed unabated for 100 years, and even in the middle of the worst plague the world had ever faced, the solutions came from this one field. Energy was now collected from trillions of nano particles in the atmosphere, each of which was too small to notice, but when combined could power an entire city. Similar nanobots had eradicated the plague's airborne particles and slowly killed off the virus.

Andrea didn't know much about nano power cells, but she did know that a lot of buildings in and around Frankfurt had solar power roofs that were no longer needed. Add to that the vast, empty buildings of the downtown core, and it meant that everyone could have an apartment building with a rooftop garden oasis instead of old, rusty panels. To avoid collapse, and to make certain that abandoned buildings were certified before re-occupancy, retrofit and inspection were mandatory – and therefore Andrea had lots of work.

Fig. 3. *The European Central Bank building, Frankfurt, Germany.*

Jurgen's site on Ruckertstrasse was a landmark – the 48-storey European Central Bank building. Empty since 2048 and recommissioned in 2094. The retrofit was almost complete after 22 years, with the entire building being converted to a greenhouse, except the top 5 floors. Andrea's bid on the south section of the 45th floor was likely to be accepted, as he had even offered to quit his inspection job to be the maintenance manager.

Jurgen showed Andrea the building records, architectural plans, the 45th floor, and finally the rooftop. They both sat on a bench, surrounded by birch trees beside a path to an as-yet-unplanted garden.

Even sitting, Andrea's shadow completely covered Jurgen. "Everything checks out, Jurgen. You've got your building certified for occupation."

*Jurgen stood up, looking Andrea straight in the face and said, "Well, that's good. I heard you also got accepted as maintenance manager at last we*ek's meeting. Enjoy your half of the 45th floor!"

3.4 E-platforms in Urban Farming

As mentioned, the United Nations estimates that by 2050, the world's population could reach 9.6 billion people. It is an enormous challenge to feed a population growing at that speed. Urban farming has the potential to produce more food at a quicker pace, with existing arable land limitations. Formerly, urban farming contributed a negligible amount of the world's food as overall production costs were higher per unit of production than traditional farming. However, factoring in location and multi-use surfaces, those costs could go down. The availability, accessibility and suitability of plots of land is of significant interest to urban farmers and we cover some existing sharing communities and technologies trying to address these issues.

3.4.1 IoT in Urban Farming

Before discussing some of the existing platforms, we wanted to point to a potential meta-platform that is ubiquitously emerging due to a change in wireless technology. The internet of things (IoT) is a concept and group of technologies that imbed constant contact with a central or cloud server into everyday products. This can be any instrument or machine, from health-monitoring devices to refrigerators. In urban farming, the plethora of devices now being marketed can have a significant impact on reducing costs and increasing yields, permitting monitoring and remote management of growing crops. What is currently work-intense, could quickly be automated with IoT devices. For example, watering and fertilizing plants, or adjusting the ambient temperature on a daily basis, could be triggered by parameters set days, weeks, or months in advance. One example of a micro-level platform, Bitponics (www.bitponics.com) can simplify this process, permitting urban farmers to monitor and maintain their gardens from any smart device such as tablets or smartphones. It is also possible for urban farmers to follow their plans through notifications. Figure 4 visualizes how the platform operates.

Fig. 4. *This diagram illustrates the communication between the sensors, Bitronics Cloud and user's computer or tablet.*

3.4.2 Sharing Backyards

City Farmer, in Canada, sponsors an innovative and pioneering platform called Sharing Backyards, which attempts to foster urban farming by connecting resident gardeners with local resources. The cross-continental spread of "Sharing Backyards" includes an interactive map of cities displaying and publicizing shared garden spaces. Moreover, homeowners can freely share their land and garden, contributing to existing projects (City Farmer, 2011). Physical activity and access to fresh produce are important benefits which are also highlighted in the gardening community of the "Sharing Backyards" project. Indeed, this project is a mechanism to promote health and well-being in terms of physical activity, nutrition, psychological well-being and social interaction.

From a critical point of view, two challenges emerge with the above system. Firstly, finding appropriate matches of personality, needs, interests, and desired outcomes is not as self-evident as one might hope. Some kind of contractual agreement or Notice of Intent should be drafted to clarify expectations regarding work, water usage, weeding, sharing yields, and when or how to end cooperation. Secondly, geographical location and individual level accessibility cannot be overstated. According to one study, only a small pool of participants were recognized as able to create an "ideal" partnership (Blake, A. & Cloutier-Fisher, D., 2009). In Figure 5 one sees a sample city from their webpage.

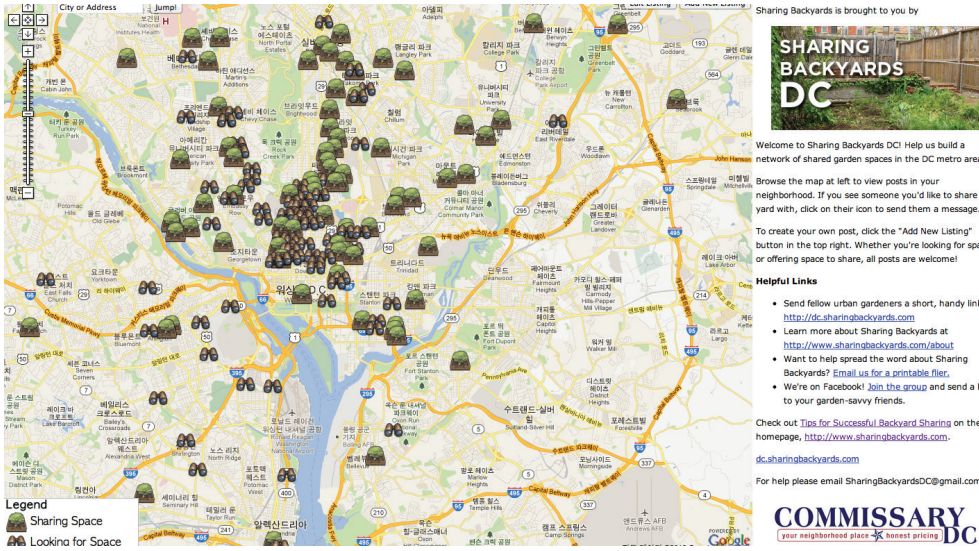

Fig. 5. *This is how the "Sharing backyards" platform looks like for the city of Washington DC.*

3.4.3 Urban Garden Share

From the western states of Washington, Oregon and California, to the southern cities of Atlanta and Louisville, Urban Garden Share is an online platform in the U.S.A. that aims to pair together gardeners with gardens. The garden owners can seek cooperation and provide an opportunity to share their land with other people. A message service developed in order to provide user interactions makes this platform a great example of how to connect land, activities and people. In Figure 6 the reader can see how the service looks like.

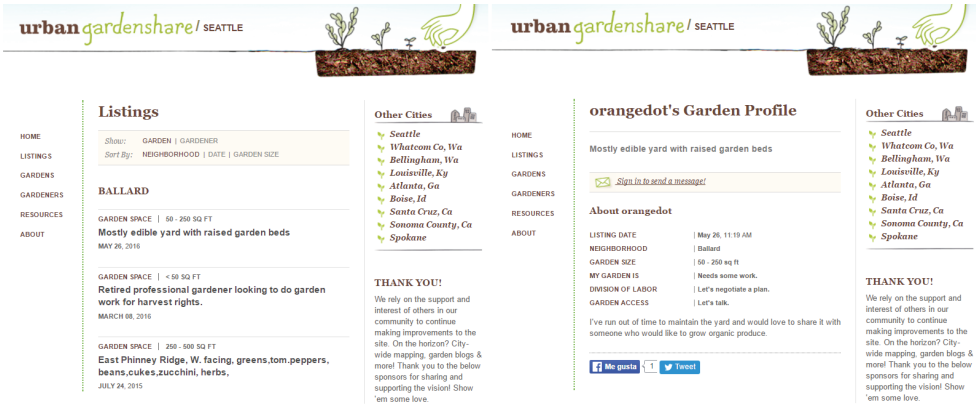

Fig. 6. *The left screenshot shows how the service provides the listings in a city. On the right, an information about a selected backyard.*

3.4.4 GrowIt!

GrowIt is an online platform that provides a mobile application connecting gardeners living in the same area. The application allows its users to share photos of their plants, to rate them, to ask for help identifying plants, to see what other people are growing and to get useful information about plant care. Users create and share information about their plants and interact with each other by giving feedback on pictures, posting messages or following other users. Moreover, GrowIt provides its users with the ability to create a project plan which will then be automatically populated with a shopping list of appropriate plants. This platform was developed in order to close the gap between industry and consumers by providing users with information about people's preferences and requirements. One of the principal objectives of this platform is to create an initial database of information about plant care aggregated by professionals and to improve the quality of the platform simultaneously. This platform is therefore a starting point for the design of a complete system that helps to create value for its users by providing interaction through digital means. Figure 7 shows what the platform looks like on a smartphone.

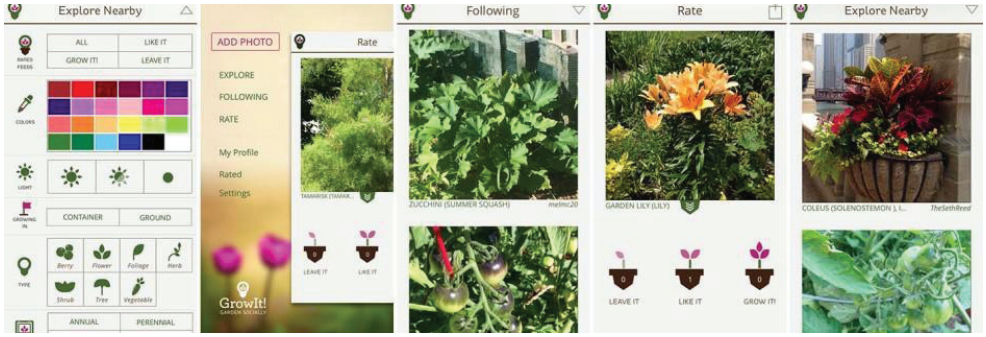

Fig. 7. *Screenshots of the service operating on a smartphone.*

4 Current benefits & challenges

As mentioned, urban farming is gaining a lot of attention worldwide (Levkoe, 2006; Mendes, 2008; Vogl, 2004). This growth is bringing many benefits and we will touch on some of them here. It is not our intention to overlook the significant political and industrial powers that come into play when discussing food scarcity and the imbalance between consumption patterns in Europe, North America, South America, Africa, and Asia. That said, as we are aware of these greater forces

we choose to overlook them with a view towards individual agency - the ability of an individual to have an impact on their local surroundings, which may or may not have a larger societal or environmental impact. In this respect, perhaps we would apply the term "Glocal" (Global-Local) to our perspective. Before we go there, however, a dystopian future is offered in regards to urban food production.

Kaisa and Isaac

Picking up glass off the floor, slowly so as not to cut herself, Kaisa recognized she was shaking. The adrenaline of the break-in, the police, and the intruder were gone and now she was drained empty. Gritting her teeth, she stood up with the largest pieces and said in a clear voice, "Isaac. Vacuum." A slight pulse and a panel opened near the bedroom wall. Isaac, one of many Isaacs in her home, came out, a rolling, squat hygiene machine hovering a few centimetres off the floor, and started to suck up the small bits of glass, while also washing away the odd drop of blood. Her blood.

The door to Kaisa's apartment had a frosted glass window. At 5 a.m. this morning, awakened by yelling in the hallway, she stood near that door and listened.

"You've got to share. We're starving." The voice roared at everyone in the building.

"They won't. They never do. They don't care!" a quieter voice hissed.

Not realizing that her head was casting a shadow on the frosted glass, Kaisa was caught off-guard as shards went flying into her shoulder and a larger piece cut her leg. The noise was a mixture of one thud followed by dozens of tinkling bells. A hand came through at the same time searching for the lock. The door was double-bolted and had a magnetic seal – it would not open now that the alarm was ringing. The arm however, still sought for something to grab a hold of.

A young man's bearded face appeared in the small opening that had been made, and he spoke in a calm voice, "I don't think you understand how little food we have." Then he bared his teeth like an angry dog and boomed out, "Give us your food! Food! FOOD!" Then he roared like a bear.

Kaisa realized he was both voices, talking to himself as two people might. Police sirens were wailing in the background. A few minutes is all it took and before he could run away, she heard two police officers pulling him back, subduing him, and then, after several minutes of one-sided chatter as they made their reports to a central server, ringing her door.

"Isaac. Medikit." She called out, crouched by the door. She reached up to release the locks, and the officer gently guided the steel and wood door back. A small drone floated near Kaisa as she stood up. It was scanning and evaluating her cuts. "Home care sufficient," it hummed "No need for external medical attention."

The policewoman before her was small, wiry, and yet seemed to have a sense of humour as she waited for the drone to finish analysing Kaisa. "Officer Vikman,

miss." And then after taking a quick look around said in a voice far too energetic for 5 a.m., "You have quite a crop, Ms. Koskela. Third attempt this month, isn't it?"

"Yes. This was the first time someone got through the downstairs security, however." Kaisa responded, lifting an arm as the drone sprayed anaesthetic on her hip and removed a tiny piece of glass, tucking its arm back underneath as a bee in the olden days would have done.

"Tomatoes?"

Kaisa became frustrated, as she knew exactly where this line of questioning was going. She smiled knowingly, "Yes. And zucchini."

The small, dark-haired policewoman, shook her head and clicked her tongue, "Like growing your own gold."

"May I offer you some, as a thank you?" She said sweetly, hiding her anger at the security firm that had failed at the street level, "There will be a kilo of tomatoes that I could give you next Friday, if you have a chance to swing by. I'm sure you and your partner can accept my appreciation, no?" Tilting her head, she already knew they would accept the bribe. Getting police protection for a garden of this size was expensive; 240 square meters of apartment with nearly every bit of floor space filled with closed-system aquaponics gardens in racks up to the 3.3meter high ceiling. Accelerators offered by Isaac, her personal Other, keep the tanks maintained with both nanobots and visible, old-fashioned robotic elements. There were six apartments in this building and each had to maintain a good relationship with the security firm (which was already in trouble) and the police (who were never in trouble).

"A kilo?!" she exclaimed. "No. My goodness, that's too great a gift. No. No." She waved her hand loosely around, and then, "500 grams each for Officer Rissanen and myself would make wonderful Independence Day gifts, however. Up to you, of course. And Friday is my day off." Officer Vikman smiled, and Kaisa smiled back.

"See you Friday, Officer. And thank you again for coming so quickly." Kaisa leaned on the door for a moment, as Vikman walked away. The assailant had already been removed by Rissanen. She slowly closed the door. Turned to look at the broken glass on the floor and said "Isaac. Repair the window on the door please."

4.1 Social cohesion

Formal urban farming can be traced back to the second world war when there was a need for food, beyond what was being produced for the war effort. Many urban parks, gardens and recreational areas were converted for food cultivation. After the war, in the 1950's, and with the expansion of transportation and supermarkets (Iles, 2005) urban green spaces were dedicated to play and recreation and cultivation reflected this focus. That said, apart from the measurable benefits of

urban farming such as job creation, stormwater management, managing heat and air circulation, etc., there are also many potential benefits that cannot be measured with the same indicators. One example is reconnecting people with the land. The privilege and joy cannot be monetized when some experience making their own food, using their own rooftop or backyard to create peaceful and friendly spaces, or relaxing in their own or shared space while adding greenery to cities.

While each individual urban farmer will have their own reasons for being involved, and these will be diverse, we nonetheless see possible benefits that are common. Residents conducting frequent business locally, within their own neighbourhoods, such as exchanging seeds, labour and knowledge has add-on effects. These might include strengthening connections within the community, providing cohesion and understanding, and creating a safety net for more difficult times.

A study by Kraut, et al.,(1998) indicates that the introduction and significant usage of technologies, such as TV and Internet considerably reduce social interactions (i.e. within the family and local social networks). Furthermore, as a consequence, such usage isolates people and increases feelings of loneliness and depression. In general, people tend to find it difficult to establish emotional or personal relationships within a new community or neighbourhood. Urban farming could help residents to foster a sense of community by simply providing frequent communication due to their common needs, activities, and interests.

There have been extensive studies on the health benefits gained from urban farming. Armstrong (2000) studied twenty community garden programs in upstate New York consisting of 63 gardens. He noted that such gardens are useful for neighbourhood development, health promotion and increased physical activity. Growing food within urban areas by residents brings health benefits, by eating fresh food products, eating in season produce, and spending more time outside doing physical work on the land. As described in a previous research study (i.e. Ross & Haynes, 1988) physical activity such as gardening is positively correlated with well-being. A study by Kaplan (2001) indicates that when residents have natural elements, such as trees, lawns, and flowers visible from their windows, it contributes substantially to residents' satisfaction with their neighbourhood and with their sense of well-being. Interestingly, he did not find any substantial effect with views of the sky or weather. He also noted that gardening-related activities had a significant effect on satisfaction. Thus urban farming activities not only affect the individuals who are involved in gardening but also those who are viewing it.

Urban farming can be labour intensive, time-consuming, and a cost burden which can be shared across a community by cooperative effort, rather than being borne by isolated individuals. For instance, outcomes are increased exponentially when processes are shared, such as distributed knowledge of how and what

to grow, exchanging seeds and labour, and harvesting and distributing produce. These sharing and exchanging activities provide an opportunity to build and strengthen a social network among local people. Like a virtuous circle, such community bonds lead to healthier and more successful gardens while beautifying urban communities. A study by Fusco (2001) shows that community gardening projects help to create a learning environment for school students and highlights the potential importance of gardening projects on science education - a classroom that builds intergenerational cohesion, while also providing for the well-being and nutritional needs of a community.

Urban farming can be used to improve security and safety, as Schmelzkopf (1995) points out in his study of the community gardens in Loisaida (lower East side of Manhattan in New York known as poor neighbourhood and crime-ridden area). Here, community gardens were used with the goal of reducing crime, removing the homeless, prostitutes, etc., from the streets, and cleaning up the city through beautification projects, gentrification, and economic development. Another very good example is the community gardens in Detroit, Michigan. Detroit is known as the "Motor City", the heart of the U.S. auto industry, which has experienced a dramatic economic collapse due to the breakdown of General Motors, Chrysler and Ford (Draus, et al., 2014; Colasanti, et al., 2012). This crisis forced many people to leave Detroit, but those who stayed were often left with failing infrastructure (water and power shortages), high unemployment and food insecurity. Urban farming began to flourish and has been somewhat successful, perhaps due to addressing several issues at once. For example, urban farming lead people to use vacant lands to provide fresh and healthy food where grocery stores (and cash) were in short supply. Unemployed people with low skills were recruited to produce economic growth for the community (i.e. through profits and wages, localised production of value-added, food-based commodities). Increases in social cohesion, responsibility, and social justice among residents were secondary and important outcomes of this process (Draus, et al., 2014). There is also evidence that urban farming led to a decrease in automobile break-ins and drug-dealing (Draus, et al., 2014).

4.2 Lifestyle

From various studies, it is clear that urban farming is more productive than its rural counterparts. In addition to this, a major merit is lifestyle enhancement - especially in urbanized societies.

Urbanized societies, nowadays, are more populated, the homes and work-places are less spacious, and the air quality is significantly inferior to rural

settings. Studies show that most people spend over 80% of their time indoors. This influences mental health, productivity and relaxation, especially in the workplace where stress levels are already high. Environmental activist and novelist Wendell Berry (Berry, W., 2012) coined the term "non-place" referring to those settings lacking vitality and organic connectedness. Apparently, "dead" places constitute an ever-growing proportion of our daily lives, inhabiting as we do these sterile 'non-places'. The remedy could be indoor farming. It exposes city dwellers to crop growing and farms on a daily basis, calming their hectic lives. Although indoor plants are known to induce visual and aesthetic improvement. Burchett (Burchett, M. et al., 2010) examined the effects of plant presence on negative mood states in building residents. Their research was the first empirical study to use internationally validated psychological measures for assessing the potential benefits of indoor plants. The presence of plants correlates positively with worker productivity (Lohr, V. et al., 1996) as well as significant reductions in negative mood states and levels of stress among building occupants (Burchett, M. et al., 2010, Dannenberg, A., 2011, Bringslimark, T. et al., 2007, Dijkstra, K. et al., 2008, Grinde, B. et al. 2009, US Environmental Protection Agency, 2000).

Beyond the psychological benefits, plants improve the air we breathe by ameliorating volatile organic compound (VOCs) emitted from synthetic materials or plastics, such as furnishings, furniture, and equipment like computers and photocopiers, and carbon dioxide from others' breathing. Cleaner air has also been found to have a causal relationship with better cardiovascular health and mental acuity (US Environmental Protection Agency, 2000, US Environmental Protection Agency, 2003). In Burchett's study (Burchett, M. et al., 2010), it is stated that just one plant within the workspace can significantly enhance staff morale and simultaneously promote well-being and improve performance.

Such an improvement on air quality can raise productivity at work by 12% and lessens common symptoms of discomfort and ailments at work by 23%. This in turn reduces absenteeism and staff turnover cost (Andrews, K. 2013). One study (Gray, T., 2014) examined the effectiveness of office spaces with plants, in which individuals were asked to compare previous worksites with a current biophilic office (summarized in Table 1). This data shows the obvious preference for the biophilic site, in some cases by a very wide margin. Figure 8 is a photo of an indoor office space with tomato vines suspended above conference tables, as a part of the working space in this Japanese office, by Kono Design.

Fig. 8. *An indoor farm at Pasona Tokyo Headquarters.*

Table 1. *Rating biophilic office against previous offices that respondent have worked in (score out of 10, 1 = very poor, 10 = excellent) (Gray, 2014).*

Rating of Biophilic Office	Rating of Previous Office Sites(s)	Respondent
9	5	1
8-9	6-7	2
8-9	6	3
8	3	4
8-9	6	5
9	7-8	6
8	1-2	7
9	3-4	8
8	5	9

4.3 Urban sustainability

Urban farming can foster ecological urban sustainability in many ways. All urban vegetated structures deliver ecosystem services, ie., the benefits people obtain from the ecosystems (Millennium Ecosystem Assessment, 2005). As urban areas grow bigger (urban sprawl) and more dense (an ongoing densification trend) the importance of well-functioning and well-connected green infrastructure networks delivering ecosystem services is apparent. Urban farming can create a new layer of green infrastructure with multiple benefits.

Ecosystem services are divided to three classes: regulating, provisioning and

cultural services (MAES et al. 2013). Provisioning services that urban farming can potentially deliver are quite obvious: food and biomass. Also cultural services are easy to detect: people can experience recreation, inspiration and aesthetic experiences by urban farming. Also education, tourism and even spiritual values can be attached to urban farming.

The regulating services delivered by urban farming are not that self-evident, because the benefits are more or less invisible. However, urban farming can affect positively local climate regulation, air quality regulation and the water cycle, because living organisms and ecosystems filter stormwater, remove pollutants, create shelter and buffers against natural disasters, smells, noise and visual harm. Urban farming creates also habitats for animals, especially pollinators that are important for provisioning services, and support soil formation, soil fertility and the nutrient cycle. Furthermore urban farming can contribute to climate change mitigation and adaptation by carbon sequestration and moderation of extreme events.

Consequently urban agriculture can have a very significant role maintaining and building a more suitable urban environment (Yang W. & Zhou Z., 2014). The vegetation coverage and ecosystem service value has a positive relationship and therefore open air urban agriculture fosters positive effects that have already been recognized with parks, gardens and other traditional green areas in urban settings. In urban planning, farming activities could be used especially as buffer zones in between natural areas and more intensive land uses, enlarging green areas.

Additionally urban farming has the potential to develop a strong local identity. In city centers, urban farming can create a new dimension to a desirable urban vision, as has happened in New York (Cambell, 2016). The promotion of a sustainable and local food system in the city is now seen as part of the mission of a good administration. Urban farming has been added to the list of prevailing municipal goals.

In periurban areas, farming activity can help the transition from a mere surface for housing, services and metropolitan functions to territorial public space, where food production is helping to redevelop a local identity (Poli, 2015). Farming activities can reverse the process of peripheralization and establish the fostering of local heritage, promote ecological functions and regenerate urban form. Agriculture can be linked with other activities such as food trade, tourism and sports and thus create new multifunctional spaces, making the most of being located near the urban core.

4.3.1 Competing fields

One of the changes in the current debate relates to government interventions in the form of building regulations. A stronger commitment to sustainability has led certain national governments, namely France and Germany, to consider insisting that

new building plans include rooftop usage. One of those uses is obviously the garden, green roof, or other such variants. The other major focus is solar power generation. Both of these choices are, in our view, excellent initiatives and we look forward to the results of either as cities renew their skylines. However, in the short term, solar power is likely to gain more attention due to its "Set-up and forget it" business model. Pay up front for panels and then reap the benefits in power generation, lower electricity bills, etc. What has perhaps made this even more timely is Tesla's November 2016 purchase of SolarCity (https://www.tesla.com/solar?redirect=no), firms which both have Elon Musk as a major shareholder. SolarCity, and now Tesla, offers a glass tile roof in which each tile is a mini solar panel. From Tuscan red ceramic to grey slate, these tiles are as good looking as existing roofing tiles, but when plugged into one another, create an integrated solar panel the size of the roof. This eliminates the need to install solar panels on a frame that adds weight to existing roofing material.

Although any green roof will inevitably take space away from possible roof-top solar panels, integrated or otherwise, we see wonderful opportunities for greenhouses, glass solariums, and other possible light rooftop buildings, sheds, etc., to compensate. As well, any power generated could be combined with heat loss from buildings to warm and circulate air within an enclosed green roof. Humidity and air conditioning collectors could further provide water supplies that previously were vented into the city.

4.4 Financial sustainability

People usually join social communities in order to find and or share information and knowledge regarding their interests. In addition, they develop social relationships and meet other people to achieve a sense of being part of a larger social group (Ridings, Gefen, 2004). As discussed briefly in the previous chapter, the shortcomings of existing e-platforms and applications are mostly related to how interactions are formed between the gardeners and garden owners and also, the accessibility of knowledge databases in order to share information about urban farming experiences. Furthermore, turning a profit, covering expenses, or making a financially viable company (LLC) based on the data being created is still underdeveloped.

From a business point of view, a lack of knowledge on the part of small-scale urban farmers hinders them from extending their work to produce for large scale markets. One outcome of this dilemma is that small producers might not be welcome at large-scale markets and subsequently, are not able to meet consumer demands and desired prices. Consequently, most small urban farmers are eager to provide supplementary food for their families rather than a return on

the investment they put into farming (Van den Berg,1997). According to Bunge (Bunge, 2015), plenty of startups and entrepreneurs have begun investing in data harvested from farming. This is to create a pay-service of some kind for new and enthusiastic farmers.

Entrepreneurs are looking for solutions to make money out of urban farming data, and this could be done by pursuing the market demands that give the most appropriate service at the right time to the right customers. For instance, imagine gardeners want to know which crops are in demand or under-provided today. That data could be collected from restaurant orders, organic food stores, and the existing plots of land usage and then offered for a subscription fee. Collecting that data requires savvy ICT entrepreneurs who understand what hardware, software, linkages, languages, and interfaces will lead to profitable businesses.

5 CarrotBnB as a solution

Section 3.4 demonstrated some of the existing platforms that are emerging by targeting customers interested in improving urban farming with existing technology. Although some of them are successful, their market share is limited to a few use cases. In this chapter, we propose a centralized platform that will provide basic services related to urban farming, such as: a social network for sharing location-based information with ideas, suggestions and successful/failed cases of growing specific plants indoors or outdoors; an online market for renting land for urban farming or trading locally produced products; an online community for people who want to collaborate together in urban farming. Starting the operation of this service in Helsinki, Finland could provide a collection of useful data that, once sufficiently large, would allow the platform to be extended with data-oriented services.

5.1 Introduction to the CarrotBnB

CarrotBnB is a fictional service-based platform that we propose as a way of exploiting the growing urban farming market. The considered services are illustrated in Figure 9, and offer a clear understanding of the platform's targets. The early adopters of the platform are people living in Helsinki, Finland, interested in urban farming. These users would have access to a social network where they could easily find information for growing plants in different environments for both commercial and noncommercial purposes, by exploiting the "knowledge sharing and eResources" service. This would allow inexperienced users to easily access the urban farming world, while at the same time providing experienced farmers with useful tips for

improving their growing techniques. Furthermore, the "renting spaces" service will allow easier access to rooftop gardens, backyards and other unused urban areas where farming can be done; this benefits both the people interested in growing crops near their homes, by increasing the land offerings and lowering the prices, and those who have piece of land that they are not using at the moment.

As the popularity of the platform grows, another two services would be introduced. Firstly, lifestyle oriented services such as "events and workshops" could be implemented as a section of the social network, enabling the gathering of people who share the initiative of urban farming. Secondly, the "community bonding activities" allow the formation of communities around growing food together as part of a social phenomenon; one possible outcome might be the inclusion of the elderly – a group that has both needs to be met and contributions to be made.

As a result of the already mentioned services, the local products offered would become both more, and more diverse, as greater numbers of people participate. Outcomes from this growth in volume and selection could include a virtual marketplace through CarrotBnB, targeting food, seeds, fertilizers, logistics, storage, and even urban farming related services. An overview of some options follows:

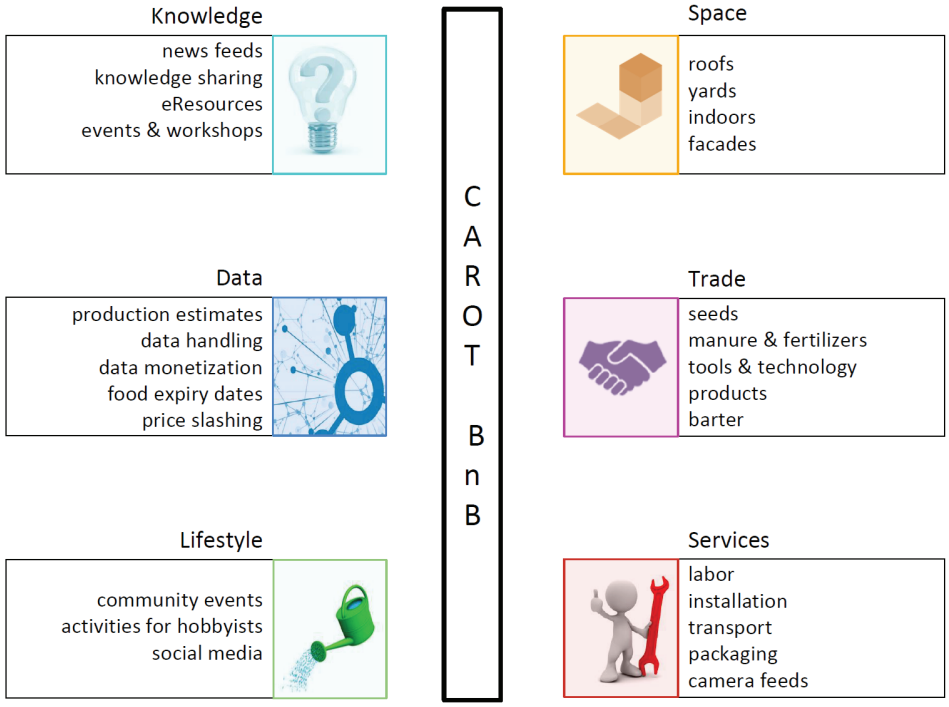

Fig. 9. *This is an overview of the services that can be provided by the proposed fictional platform CarrotBnB.*

5.2 Further development of the platform

The successful development and penetration of the platform allows the collection of useful urban farming related data provided by users. Computing this data will enable expanded platform possibilities. The implementation of big data services such as "production estimates" provides food producers and distributors the market situation. In addition, the "IoT data handling" services give users the possibility to share the data collected by their sensors with others, strengthening the platform's database.

At this point, it is very important to note the application of data and information monetization within the platform. On one side, users that share their sensor data could be paid for their information, increasing the motivation of doing urban farming. On the other side, food producers and distributors would pay for this data in order to know how much local food will be produced and, therefore, how much must be imported.

Meanwhile, the services presented in section 5.1 would be made accessible in other cities and countries following the same process outlined in chapter 5. From the ecopreneur's perspective, this platform offers the exploitation of a new, underdeveloped but growing market. Based on urban population and the environment, the platform, CarrotBnB could translate into a lifestyle changer with many benefits; some of which are presented in chapter 6.

Chapter 5 has presented a fictional platform as a technological exploitation of the current situation in the field of urban food production. Four general ways of exploitation have been presented and their overlap between each other is illustrated in Figure 10.

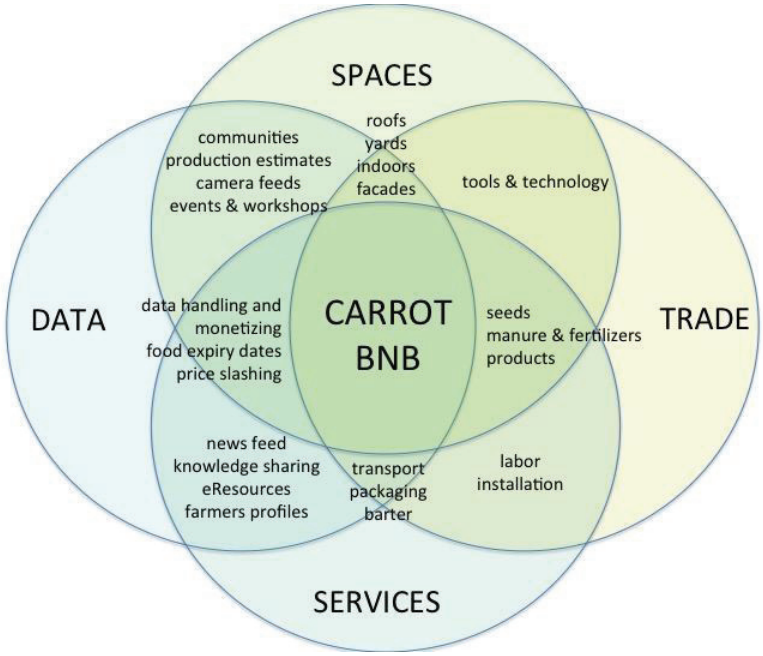

Fig. 10. *This figure shows how CarrotBnB targets the four groups of services that have been presented in Chapter 5 and how they overlap.*

6 Enhanced benefits with CarrotBnB

The proposed platform (CarrotBnB) has the potential to enhance the current benefits and provide even greater benefits locally and worldwide. However, before we go into details on those matters, we enter into another science-fiction prototype that dramatizes the underlying social relationships made possible or augmented by our fictional platform.

Mari and Peter

Mari found him, sitting and staring out the window at a pub called "Lion's Heart". He was slow to respond, but since his 77th birthday a year and a half ago, he was always responding slowly.

"Grampa Peter. Seriously. Why are you not ordering something? The bartender called me to ask if you are ok." She sat down across from him in the booth.

"Ordering?" He finally seemed to hear her. "Yes. Coffee is fine, thank you."

She waved to the bartender for 2 cups of coffee, and then turned back to Peter. "Are you ok? You seem tired."

"Yes. I guess I am. I am not sure I got everything in order before I left the garden."

He gestured feebly towards the fire hall, behind which was a public garden area of rentable plots. Folks rented them, grew vegetables, herbs, and in some cases even small, tart apples. "There's a truck coming tomorrow morning. It's our largest mixed shipment so far." He smiled and squinted into Mari's light brown eyes.

"What? How is that possible?" She seemed shocked. It had been 5 years since he went into the retirement home almost a kilometre from the Lion's Heart. At the home he had met other retirees who couldn't live on their own anymore. After a few months however, Mari, her mother Saija, and the other relatives noticed that as long as it was light outside, Peter was not at the home.

Peter held up his new mobile device, "Moh has us set up online. The buyer this time is a restaurant over on Tar Island." He looked out the window, and a gentle smile covered his face. After a few moments he said, "We covered our costs, and our seed and fertilizers for next spring with this one shipment. And it looks like we'll have 2 more before the frosts hit." He looked back at Mari, suddenly very sad. She waited for him to speak again.

Finally he sighed and reached across the table to take her hand, "You know, when your mother put me in that home, I was angry. Your grandmother died at home and I was hoping to do the same. Seeing the house sold broke my heart and for a while I couldn't talk to Saija." Still holding Mari's hand, he looked out the window, "But now, with this garden, I... I don't know... I haven't been so busy in my life. The others need me to keep everyone on track, to negotiate with the restaurants and to keep Moh and the other kids from making too many promises. It's a business, even if it just covers our costs now, but we are all agreed that we'd rather keel over in the garden with a heart attack than slowly fade to our deaths 10 years from now! Damn, it's a good feeling, Mari."

The waitress came with coffee and separate, small dispensers of milk and sugar.

Mari was relieved by the interruption as she was not comfortable with this talk about death. However, Peter seemed further from the grave than he had the day they put him in the retirement home. She asked, "Is Moh a nurse at the home?"

"No. Not really. Heh, no." he laughed a bit then, "Not at all. He and a couple of programmers live there and help out with our plans. They're at the university, I think. I guess they get cheaper rent like that. The old barter system. They live and eat with us and keep us entertained, or mentally engaged, or, well, I don't know. It's great having their energy around." He explained.

Mari raised her eyebrows, "They live there... with you?"

"Yeah." He didn't seem to hear any alarm in her voice, although she had quite a bit of concern. "They keep us going, these young guys and girls." Then he took her hand again and said, "Tell Saija to come by the garden tomorrow. I miss her. And I'm not angry anymore. Your Grandmother died six years ago. Too young. I

thought my life was over. But this garden is the best thing that's happened to me. I'll die there, but not anytime soon." He started to put on his jacket, leaving his coffee untouched. "Let's go. Dinner is soon and you should meet my new friends."

Mari paid for the coffees and joined Peter outside, walking down towards Arabiaranta, and into a glowing late-September sunset.

6.1 Social cohesion

There are several tangible advantages related to urban farming for social cohesion, including increasing the social bonds and networks within communities, even at the street or block level. Such bonds are arising from the mutual goals, trust and support people have with one another, and may even foster social integration among people with different cultures, religions, socio economic classes, genders, ages, and educational backgrounds (Firth, et al., 2011).

Building a platform to connect urban farmers together has utmost importance in terms of social cohesion, enhanced educational and skills development, information sharing, and even job creation. A platform that can integrate data collected in diverse settings and redistribute said data in forms that benefit individuals, businesses, and communities, is worth its weight in gold. Adding to that the provision of healthy, locally grown organic food, and this platform can only be seen as a treasure trove waiting to be dug up.

As Yotti and Townsend (2006) noted, social capital is improved even from small qualitative urban farming, leading to benefits of increased social cohesion, social support and social connections. As they clarified, such benefits extend beyond the garden setting. Therefore increasing areas for urban farming will lead to higher social cohesion, which can be encouraged by this proposed platform.

CarrotBnB proposed here can be used as a strategy to solve a cohesion problem we face in the modern era. One hears much about anxiety and depression after retirement or unemployment. For many in society, being retired makes them feel unneeded. The problem lies in the difference of being productive at work versus being unemployed or retired. During this period of life, it is common to feel bored, depressed, and anxious. Also, in this modern era with the use of technology where the generation gap can be felt clearly and where many people live far away from their families, intergenerational activities are few and far between. However, the question of how to cope with these issues can be addressed in part, through the proposed platform - CarrotBnB. The elderly can be reconciled to technology and through it build connections between those who are interested in the same gardening activities. This is a small step towards helping with depression and anxiety.

Services provided by the platform can have a great scope especially in the Nordic and other western countries where population is aging at a fast pace. We see similar initiatives, albeit more focused, initiated with multi-stakeholder interests included. For example in Finland, the City of Helsinki started a pilot project "Oman Muotoinen Koti" (The House that Fits) (City of Helsinki, 2016) program in 2016, providing subsidized accommodation to young adults (under the age of 25) in the city's Rudolf Seniors Home for one year (Macguire, 2016). Obviously, reaching out to both the elderly and our young is a civic priority and CarrotBnB could be part of a greater movement towards one, cohesive social sphere.

6.2 Lifestyles

We constantly look for new and beautiful ideas from the homes of our friends and co-workers, from print publications and books, to shops and galleries locally and around the world to find inspiration. Instagram (Instagram, 2016) has become one of our favorite and most fulfilling places to search for such ideas and also to showcase our ideas. We even start hashtags to propel the visibility of our favorite photos. There are many independent artists and photographers creating their own content in Instagram or other related services. For example, a quick search on Instagram for house plants reveals the variety of related content, a sample of which is depicted in Figure 11 (#houseplants, 2016). However, why not have a dedicated platform for indoor plant and urban farming photography? The answer could be CarrotBnB or any other centralized platform with an Instagram-like functionality integrated into it - dedicated to plants and green living. It would help to build a sense of e-community, encouraging people to live healthier lifestyles through art inspired by urban/rooftop/indoor farming, and could provide educational opportunities to learn from where food comes. Besides, with all the facilities tied to CarrotBnB platform, it would be easier for indoor plant enthusiasts to buy or procure related products and services, and devote their time to create this eco-friendly art.

Fig. 11. *Galleries with #housepants search on Instagram.*

The platform can be envisioned to provide green services in commercial settings such as offices or workplaces where the stress level is high. Not many businesses are dedicated to indoor farming for lifestyle enhancement. Even if such services are available, they are not integrated into either the architecture or design of work flows or customer/employee interaction environments. CarrotBnB could also act as an inspirational source or an educational supplier with various news, stories and case studies reflecting the importance of indoor farming as a lifestyle booster, to help companies adopt green environments for their offices and workplaces. With CarrotBnB in existence, office owners can readily browse interesting services for their spaces, where they find many players offering related services as packages. Resultant, this provides small scale business opportunities to local players and other entrepreneurs, which through the CarrotBnB platform, advertise and sell their services.

6.3 Urban sustainability

Food production presents a unique challenge for urban planning. Unlike traditional infrastructure like sewers or streets, typical urban food infrastructure is mostly privately owned. It is shaped by the tastes and decisions of individual consumers. The relating complicated and interrelated factors

are not easy to influence or understand, but a platform like CarrotBnB could make it easier.

The CarrotBnB can deliver much needed metadata about prevailing trends and habits of urban farmers and consumers. Data could be used to administer urban farming so that it is, for example, located and maintained in favor of other urban functions and objectives. Cartography extensions of CarrotBnB could be used together with master and detail plan maps to coordinate urban planning efforts like locating food markets or other related business places close to production.

The public sector has an increasing lack of resources and hence collaboration with private sector actors is important, especially in terms of sharing the responsibility of maintaining public and green areas. Urban farming can offer one forum for the involvement of residents in the maintenance load. The platform could be used by urban planning authorities to indicate proper locations for farming or delivering "packages", where a farming licence of a site would include some maintenance responsibility for surrounding public environments. This would help to maintain the ecosystem service value of the city and foster local sustainability.

6.4 Financial sustainability

Data monetization is the process of value creation from available data sources or information extracted by storing, analyzing and disseminating streamed data. The main stakeholders of data monetization are data producers and consumers which trade, exchange data or knowledge resulting from processed data. While data technologies such as sensors, mobile apps, cloud computing and big data analytics develop and mature, the opportunities for entrepreneurs exist to leverage on data monetization for business development. The prerequisites for data monetization are already in place: massive amounts of structured and unstructured data; Low and continually decreasing storage costs; competitive data-driven marketing; and improving business intelligence by enhanced data analytics techniques. For example, significant number of companies have a successful business model that captures and stores data streaming from tractors and combines, actually harvesting grain, for example, and subsequently this information is marketed to farming companies or traders (Bunge, 2015).

The data monetization opportunities of CarrotBnB platform can be evaluated by more informed and result-driven assessing of the value of information, determining how to efficiently maximize its potential and recognize how to transform data to market efficiencies. To this end, the key criteria should be consumer categorization and behaviour, accessible data and the potential mar-

ket. The Accenture Data Monetization framework (Bohe et al, 2015) introduces key stages to help traders to commercialize their data. During the data value chain, it becomes more refined, relevant and valuable to the business. Figure 12 indicates the Accenture Data Monetization key stages for data commercialization.

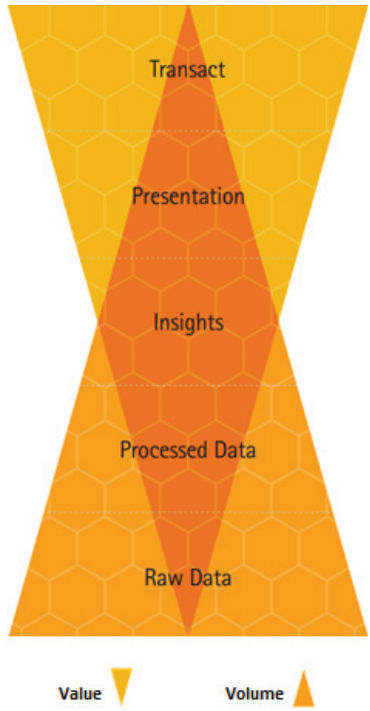

Fig. 12. *Key stages for data monetization.*

Through the CarrotBnB platform data monetization process, raw data could be collected from different sources, such as weather and soil conditions, equipment and tools, seed purchases, fertility and crop conditions and participant urban farmers' budgets. As the raw data itself does not create sufficient value to commercialize, a data analysis phase could be done in order to extract valuable insights from existing data. Obtained results are valuable assets for urban farmers, indicating where they can increase their efficiencies and qualities based on certain parameters. The actionable insights for urban farmers could include: the most appropriate time for seeds and planting, fertility knowledge, field insights, accurate budget determination, best farm plot for specific products, etc. Figure 13 shows the principal components of the CarrotBnB data monetization framework.

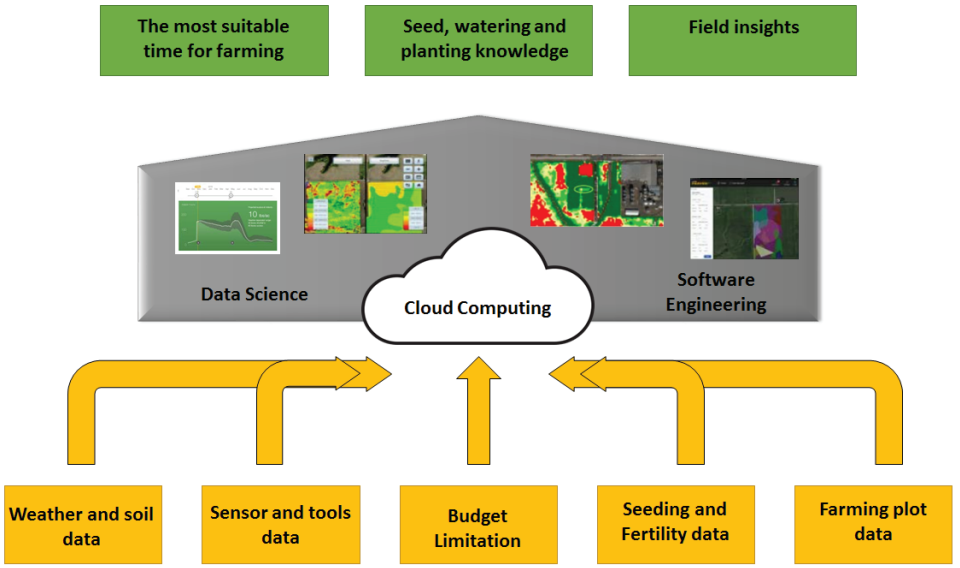

Fig. 13. *Key components that need to be taken into account for data monetization.*

7 Discussion

The current state of urban food production is a hodge-podge of professional and amateurs attempts at meeting various needs and desires - from supplementing one's own consumption to creating spaces for community building and restoration. In many places, the concept is used to encourage municipal and federal authorities to regulate the use of buildings and common spaces to promote green roofs, solar power generation, or even food gardens. In the private sector, there are sporadic attempts to match individuals with land to those who wish to grow food. The idea for a platform arose naturally from our conversations because this seems to be able to address many of the outstanding disconnects in the field today. Spaces are available but people don't necessarily know of them. There are restaurants growing food or purchasing food from urban farms, and yet this surprises many with whom we speak. Social connectivity and long-term transaction facilitation is what our fictional platform could provide. Need something for your plot of land? Ask the network. Need a buyer for your produce? Do the same - the network will respond.

Our concern is not with the physical characteristics of the platform - the underlying hardware, software, cloudware - that would make it all work. Rather, we hope that by seeing what is currently available, we are able to draw out some of the issues and sociological themes behind urban food production.

In our first science-fiction snippet or short story, Ville and Petra, we go beyond the current logistics and transportation environment and question the commoditization of food delivery. Is this what we, as developing societies desire and how would an entrepreneur prepare or create such a future? Our second story, Andrea and Jurgen, is placed in the section on existing urban farming because one of the key challenges is retrofitting buildings. How do we put tons of soil onto, allow trees to push roots through, and handle run-off from our roofs? The immediate response from building owners and managers could, understandably, be, "No. You may not use the roof." While new buildings may be commissioned with solar and green roofs, it is the existing environment that offers the greatest room for the architectural entrepreneur. E-Platforms are the current state, but they are not ecosystems as we envision our own proposal to be. As these existing technologies, applications, IoT devices, and networks come into full force, we feel that trading communities will arise. Our story of a building protected by both private security and public police, Kaisa and Isaac, is a far-future that reveals some of the tensions caused by food scarcity. We touch on existing and prospective technologies, but nonetheless wish to raise awareness of dystopic elements that may drive urban food production to the fore. Finally, before we discussed the short-range benefits of our proposed platform, we looked at Mari and Peter, a granddaughter and her elderly grandfather, discussing his own feelings of abandonment and community. This is a snapshot of what may come to be, already today with existing technologies in urban food production, but may also become more mainstream and popular given the right impetus.

8 Conclusion

We have discussed several micro-level platforms and initiatives, single city or even single purpose websites and applications that support urban farming. At the meso-level, we might see several such platforms accessing and sharing information based on user's location, time, etc. Eventually, a meta-platform could aggregate all sub-platforms from health care, taxation, property ownership, rental contracts, employment information, land usage, food needs locally and globally, fuel and energy consumption and provision, water rights and uses, etc. Through science-fiction prototyping, we perhaps can see ourselves doing and being in that future place.

In highlighting the current state of urban food production, proposing a fictitious platform that is, for all intents and purposes, plausible and possible today, and discussing the future of food production and consumption through science-

fiction prototyping, we feel that this article adds to both the academic and public discourse on an important social movement. Since the days when we humans began to live in fixed settlements, local food production has been our way of life. Perhaps a hybrid of local, national and international logistics, motivated by a desire for community and sustainability, will make urban food production a major field of entrepreneurial activities in the next few decades.

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Interviews

1. Kivireki-workshop 10.10.2016 in Tampere organized by TAMK, Tampere University of Applied Sciences presenting the preliminary results of Kivireki -pilot project aiming to create, develop and test new entrepreneurship possibilities of local urban farming

2. Juhamatti Niemikapee, a doctoral student in the Department of Environmental Sciences in the University of Helsinki. Hiss research nurtures an interdisciplinary approaches to green roofs, urban ecology, environmental sciences and biology. Interview was made in October 2016.

Overtaking an Industry on the Verge of an Unforeseen Technological Disruption

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ABSTRACT: *This paper proposes a strategic framework of innovative approaches that can disrupt stable industries through unique competencies. This disruptive process creates a competitive advantage for the technologically disruptive company. The identified factors that lead to success derive from the automotive industry. An unforeseen technological transition in this industry has occurred following the successful market entry by an electric car company, Tesla Motors. As the result of the analysis, we classify the approach into five categories: strong leadership, ecosystem, superior product, high-end customers, and adaptation to the new market. The extracted five main factors are applied to two other industries, biofuels and personal electronics, to help understanding the fundamentals of market transitions and creation of new ecosystems.*

KEYWORDS: *disruptive innovation, electric vehicles, biofuels, personal electronics, market transitions, ecosystem*

1 Introduction

Strategic management research has long had a central scope in understanding a) the differences in the performance of companies, b) the factors behind successful growth stories, and c) creation of sustainable business [1–3]. Traditional industries, created and settled over a century ago, are dominated by an exclusive selection of large companies which have finely tuned their operations to maximize their own efficiency and profits, resulting in a total control over the operations in the field [2]. As a result, these industries are fundamentally competitive and hostile for any newcomer. However, the global financial crisis in 2008 lowered the barrier of entry for new companies. The growth rate of the traditional manufacturing industries started to decelerate due to the crisis and the following recession. These traditionally strong manufacturing industries were under global pressure and were not able to grow at the same pace as in past decades. They had to streamline their operations to survive in the market crash. Still today, they continue to face remarkable structural changes [4] and are vulnerable to agile competitors that can quickly adapt to changes in the market.

Even though a transition always includes uncertainty and risks, they are important events that usher in the next level for many companies. For traditional industries, the next level typically incorporates higher utilization rate of technology. Companies hope that improvements in the technology will help them to better adjust to fluctuations in demand and other changes in the field. The use of technology is, however, different across nations, companies, and operators [5].

This paper analyzes examples of successful market entries that have caused a transition in the prevailing market and industry practices. First, the paper briefly presents the background of the automotive industry, from internal combustion engines to alternative fuel vehicles. This is followed by our prime example, Tesla Motors, an electric car company that managed to break into the highly competitive and traditional car market. Furthermore, Tesla Motors was also able to change the market behavior. This disruptive change is driven by a technological transition from fossil fuel cars to more environmentally friendly vehicles with added services. Second, by analyzing the actions of Tesla, we extract their strategy, from which we can identify a set of key components benefiting growth and creating sustainable business. Finally, to further understand the adaptability of the Tesla approach, we introduce case studies from two different industries and compare their perceived strategy to our proposed approach.

2 How the Entrepreneurship Changed the Automotive Industry

Disruptive innovation most often originates from outside the industry, which is in conflict with the historic notion that defines it. Since the times of Adam Smith and Wealth of Nations, it was considered that improvements come from those who are continuously fixated on the particular technology:

"When the whole force of the mind is directed to one particular object, as in consequence of the division of labour it must be, the mind is more likely to discover the easiest methods of attaining that object than when its attention is dissipated among a great variety of things." [6]

This section presents the traditional auto industry production and business model and the major changes that occurred over time until the entry of Tesla Motors. We identify the entrepreneurial actions and strategic decisions utilized by Tesla to create a new company based on innovations. Additionally, we discuss the development trends, including industry market capacity, industry growth and profit space, as well as upstream and downstream relations.

2.1 Prior Automotive Industry Model

Historically, the automotive industry knows only few large transitions: 1) the transition towards mass production initialized by Henry Ford in the early 1900s and refined by other U.S. car manufacturers, such as General Motors or Chrysler, and 2) the 1970s transition from high volume car production batches to smaller batches with increased quality control, referred to as lean production. With the perfected lean production methods, Japanese car manufacturers were able to overtake the car market by meeting the expectations of various customer segments [7].

The automotive industry has been dominated by car manufactures employing large subcontracting networks in order to minimize the component cost and, consequently, maximize the profits of the car manufacturer. As the car components are highly generic, the key attribute is the design and functionality of the whole system, i.e., the car. However, the functionality and perceived user experience is highly related to the powertrain of the car, especially, the engine. Therefore, car manufacturers typically focus on promoting the performance, and more recently, the efficiency of the engine. The next sections depict the evolution of the applied engine technologies in the automotive industry.

2.1.1 Internal Combustion Engine (ICE)

From 1807, when François Isaac de Rivaz invented the first internal combustion engine (ICE) fueled by hydrogen, until present, the automotive industry has experienced numerous changes. For the majority of time, the dominant design has been the internal combustion engine vehicle. The ICE market has different preferences in each country, depending on such factors as the income level, oil price, government strategy, and culture. To illustrate, people in countries with low price of oil and high income level have tendency to buy a car with a larger engine.

By 2022, the global internal combustion engine market is expected to reach near 200 million units. Only in the U.S., the prediction is that the ICE market moves up from 27 million units in 2012 to 40 million units in 2022 [8]. The rising demand for fuel efficient machines has resulted in engine downsizing and turbocharging, and the market share of these type of engines is expected to escalate over the coming years.

When considering only the automotive industry, developing alternative fuel options, such as ethanol and electric, is anticipated to present a challenge to the industry. However, replacement by these substitutes may be slow due to the mature technology and large ecosystems related to internal combustion engine manufacturers and fuel production. Nevertheless, throughout the history of engine manufacturing, technological improvements have continuously displaced traditional methods. Figure 1 depicts the production volume ratios of different engine technologies in contrast to the whole car engine market. In general, an engine adopting an advanced technology overtakes the market from the traditional technology and becomes a dominant design [9], until it is again displaced by an emerging innovation.

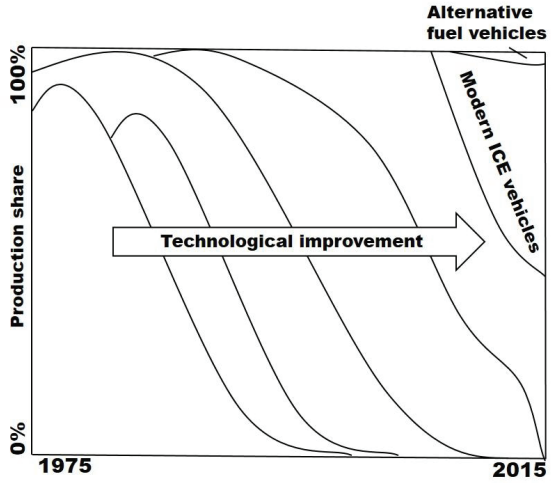


Fig. 1. *Diffusion of technological improvements in car engine manufacturing. Adapted from [10].*

2.1.2 Alternative Fuel Vehicles (AFV)

The automotive industry is experiencing a period of flux and uncertainty due to several economic, technological, and political reasons. For instance, the unstable oil market, technological advances, and restrictive regulations, especially related to emissions, require actions from the industry. Most car manufacturers have answered to the challenge by developing powertrain alternatives to the internal combustion engine. As an example, the pioneer car makers, such as General Motors, Toyota, and Volkswagen, are focusing on multiple alternative fuel vehicle (AFV) technologies by introducing hydrogen, hybrid-electric, compressed natural gas, liquefied natural gas, multi-fuel, and pure electric models according to the needs of the customers. These alternatives have entered the market in separate stages due to the differences in the technological development. Figure 2 shows the cumulative number of alternative fuel vehicles in use from 1995 to 2010 in the USA. It can be seen that the popularity of ethanol cars has increased historically, while the number of other alternative fueled vehicles on the road has remained relatively constant.

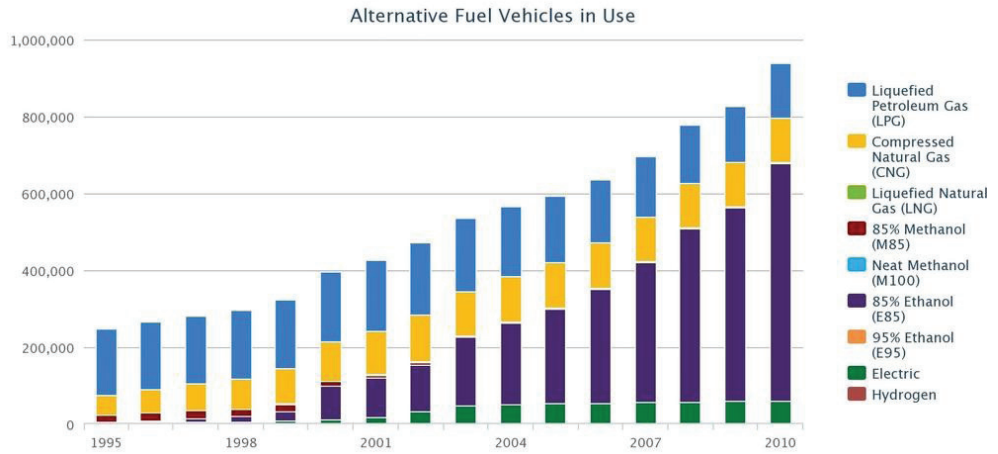


Fig. 2. *Alternative Fuel Vehicles in use in the USA [11].*

In contrast to the large vehicle manufacturers, a few smaller companies have concentrated on pure electric cars as the only alternative option for reducing emissions. This action maybe reasoned due to differentiation from the competition of other manufacturers in the early stages of the company. Furthermore, in contrast to the other alternatives, the chosen technology has several disruptive elements related to performance and use-phase costs, as stated in the following subsections.

2.2 Tesla's Settlement into the Market

Despite the theoretically favorable situation in the car manufacturing industry for the creation of new companies due to the large subcontracting ecosystems, the field was very stable, with only a few new companies during the last decades. Previous companies founded on car manufacturing were subject to an aggressive competition from the traditional manufacturers, hindering the operations of the newcomer. Among the last companies to face the challenge was Tesla Motors.

2.2.1 Tesla as a Car Manufacturer

Tesla Motors was formally filed in January 2003 by Martin Eberhard and Marc Tarpenning after trying a prototype by AC Propulsion [12]. This prototype of an electric car (named tzero) was a high-standard sport car, but AC Propulsion had no intention of commercializing it, keeping their business in consulting operations for other car manufacturers. However, the power and potential demonstrated by the tzero got Eberhard and Tarpenning interested in a different business model for such technology. On the other hand, the automobile manufacturing industry followed a production process where nearly every part of the car was outsourced to minor companies except for the engine [12]. The combination of the latter with the former, in addition with Eberhard's and Tarpenning's interest in clean technologies, propitiated the correct environment for the creation of a car based on the electric powertrain technology.

Most of the technology necessary for a high-class electric car was known since the 1980s. However, the limiting factor for the construction of a competitive electric car was the autonomy, i.e., the battery life. This technology has experienced a slow development, duplicating its energy storage capacity every 10 years [12]. Moreover, the battery research was centered on applications such as laptops, with only a small sector focusing on high power applications.

In 2004, Eberhard and Tarpenning started the series A of funding, raising money for the company creation and designing of the first prototype. At this point, Elon Musk invested in the company and became the chairman for Tesla's board of directors [12]. Following this initial fund-raising, the company had 9 employees and began designing a car named the 'Mule' as a proof-of-concept.

By 2006, the company had built a drivable version of the Mule along with 10 prototypes for crash testing and further research. Tesla Motors also started exhibitioning their prototypes in several auto shows to gain reputation in the market. Later on, in 2007, the concept car, now named as the Roadster, was built to function as a Validation Prototype (VP). Finally, in March 2008, after clearing

the validation tests, the company began production of the Tesla Roadster [12]. At the end of 2009, the company staff counted over 500 individuals and had sold 1000 Roadsters in total. In January 2010, Tesla registered for the initial public offering (IPO) of stock.

2.2.2 Tesla on the Stock Market

The commercial success of a publicly traded company is clearly visible on the development of the company stock value, especially due to the expectations of future profits. Furthermore, the stock value portraits the trust of the market in the company and can also act as a supportive indicator enticing other companies to contribute to the company ecosystem.

Tesla Motors began the IPO on 29 June 2010 on NASDAQ. This IPO raised more than 200 million dollars, being the first American car manufacturer to release public stock since Ford Motor Company opened in 1956. The success of Tesla is visible in the stock value. Already in 2014, the stock reached a total value half of that of Ford.

With the raised funds, Tesla was able to start Model S deliveries in 2012. Between the time of the IPO launch until the first quarter of 2013, Tesla experienced a slow increment in the stock value, as demonstrated in Figure 3. The stock value surged after a report on unexpectedly high sales of the Model S during the first quarter of 2013. In June 2014, with the increased trust to the company strategy, reflecting also on the high stock value, Tesla started a project to build a massive factory, labeled the Gigafactory, to produce electronic batteries in cooperation with Panasonic. After starting to build the Gigafactory until now, Tesla's stock value has remained relatively high in contrast to the reported financial results.

Fig. 3. *Stock value of Tesla Motors in U.S. dollars.*

The market value of Tesla is affected by multiple external variables, causing variance in the stock price. However, the impact of each variable on the actual business and financial results depends highly on the adopted strategy and processes inside the company. As an example, investors could fear that continued low oil prices may convince consumers to choose gasoline powered vehicles over an electric vehicle, such as the one produced by Tesla. Consequently, the stock value of Tesla would decline, with investors overselling the stock. However, the actual sales could still be strong, and when reported, would cause an increase in the valuation of Tesla. For example, according to Tesla's fourth quarter earnings report in 2015, during a time of historically low oil prices, Model S was the only vehicle in its class with growing sales. Reports by Tesla also reveal a large amount of sales for Tesla's new SUV, Model X, and a record-high interest for a compact sedan, Model 3, reaching near 400 thousand preorders at the presentation (March 2016). When the manufacturing infrastructure is completed, the production is expected reach 500 thousand cars per year.

2.3 The Industry Under Transition

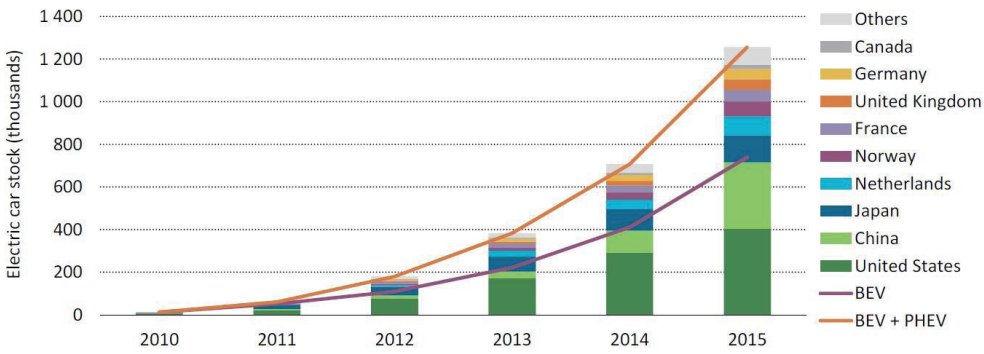
This section portraits some of the structures and trends guiding the automotive industry in the near future. Evidently, there is a shift toward greener technologies and enhanced user experience.

2.3.1 Eco-innovations and Technological Transitions

Eco-innovations, defined here as technological advances that reduce the environmental impact of automobiles, have a promising potential in the automotive industry. These innovations follow the usual technological transition procedure, with the advantage over the previous developments that the environmental impact produces a general benefit to the society. Furthermore, the incentive through governmental directives of these technologies increases research and further development as well as the adoption of eco-innovations by consumers and producers [13]. The policies related to induce environmentally-friendly innovation are generally described as technology forcing or market based [14]. The former refers to product-related policies directed towards the production chain, for example, in the form of pollution reduction targets. The latter entails subsidies or pollution taxes, encouraging innovation as a means to increase competence in the market. Both of these policies have been present during the establishment of biofuel vehicles in the U.S. [15].

More recently, the shift towards electric vehicles has been apparent. For instance, complementary to CAFE (Corporate Average Fuel Economy) standards, the California Air Resources Board (CARB) Zero Emission Vehicle (ZEV) mandate seeks to increase vehicle efficiency and reduce emissions through a targeted effort to introduce vehicles with zero emissions on the road [16]. Given that tailpipe emissions are inherent to vehicles with internal combustion engines, it is unlikely that many, if any, of the required zero-emission vehicles will utilize traditional motor fuels or those that fall under the current taxation regime. Instead, the expectation is that these vehicles will be electric drive vehicles that will generate electricity on board from hydrogen or use stored electricity charged from the power grid. California is requiring that 22% of vehicles sold by major automobile manufacturers produce zero emissions by 2025. Nine other states have exercised the option of adopting this standard as well. If all these states adopt California's standard, it is projected that up to 800,000 light-duty zero emission vehicles would need to be sold annually by the automakers by 2025 [17].

Tesla Motors has been approaching the selling of electric vehicles not from the regulation point of view, but focusing on the user experience. Thus, their business model is less reliant on regulation policy than those around other alternative fuel vehicles, which also suffer from highly volatile fuel prices. Furthermore, electric vehicles have less moving parts, requiring less maintenance, which contributes to higher customer satisfaction. The compelling powertrain technology and related captivating user experience is also visible on the worldwide success of electric vehicles. Figure 4 reveals that electric vehicles have exponentially growing vehicle stock in Europe, North America, and especially in Asia.



Note: the EV stock shown here is primarily estimated on the basis of cumulative sales since 2005.

Sources: IEA analysis based on EVI country submissions, complemented by EAFO (2016), IHS Polk (2014), MarkLines (2016), ACEA (2016a), EEA (2015) and IA-HEV (2015).

Fig. 4. *Cumulative stock of electric vehicles (also hybrid and fuel-cell) [18].*

2.3.2 Connected Services

Energy sources are typically in the center when discussing about electric vehicles and their environmental impact. From the power grid and electricity production point of view, there is a potential to employ electric car batteries as a demand and supply stabilizing resource. This would help in the integration of intermittent renewable power generation, such as wind and solar. For the owner of the car, this potentially enables optimization of self-consumption. On the other hand, the grid operator could reduce the infrastructure investments, as they could rely on the car battery resources to balance the power flows in the grid.

In addition to the clean, high-performance powertrain technology, Tesla is perhaps the best-known example of highly embedded driving assistance features, even though such technology has been around for years if not decades in some form. It is highly likely that the autonomous driving will happen to a significant amount during the next decade, as influential companies, such as Google, push it forward. Already, Tesla's car models have inbuilt communication system that enables over-night updates to the software of the car. It revolutionizes the basic concept of cars, as your car does not just depreciate its value as time goes by but becomes better after each update.

From the car manufacturers' perspective, the future looks uncertain in many ways. It has been estimated that more than 90% of the time, cars owned by individuals are just standing still, only occupying space [19]. The introduction of autonomous driving as a business will result in the reduction in new car demand, putting the 90% car reserve in circulation. The new ecosystem and profits move from products to services, as is typical across industries. The traditional car manufacturers need to be able to diverge a portion from this revenue stream, for example, by commission-based charges. Thus, the traditional car companies are investing a lot of resources into the autonomous driving collaborating with companies outside the traditional car industry. Large information technology companies, such as Facebook, Google, or Apple, have the potential to scale up as individual companies in the field of smart transportation.

The autonomous driving requires high-speed connections in order to achieve optimal transport efficiency and collective behavior for all the cars on the road. In Finland, the government agency Tekes (the Finnish Funding Agency for Technology and Innovation) is strongly supporting the platform around Mobility-as-a-Service (MaaS). The aim is to find future bottlenecks and places for improvement to enable "crossing the chasm" [20] between early adopters and the early majority. This project by Tekes has 5G connectivity and open innovation platform as the main objectives to enable fluent communication between all the

cars, databases, and service platforms. However, in the case of autonomous cars, it will be difficult to move from innovators to early adopters stage without policy and regulatory changes. This can be also compared to the "pre-chasm" description by Moore [20]. The next section describes the primary factors to overcome these challenges of diffusing the innovation into the market.

3 Primary Factors for Disrupting an Industry[1]

Performance of companies can be analyzed by identifying their assets, or resources, and the produced outcomes. High-performing companies have resources that bring competitive advantage in contrast to less successful companies. In case a resource has value and is rare, in-imitable, and non-substitutable, the resource is considered as a source of sustained competitive advantage [3]. This theoretical concept is known as the resource-based theory.

According to the Innovator's Solution by Christensen and Raynor [21], a disruptive business model is a valuable corporate asset. In [2], a disruptive strategy was monitored to increase the chance of creating a successful growth business by more than sixfold. We figured out that the introduced case of Tesla Motors comprises all the main factors important for the successful explosive growth of a company and the resulting disruption in the industry. These factors include strong leadership, effective ecosystem, superior product, and early focus on high-end customers. In addition, to have a sustainable competitive advantage, the company has to have a long-term strategy regarding the positioning of the company in the disrupted market. These five factors are analyzed in this section to explain the role of disruptive approaches on industry shifts.

3.1 Strong Leadership

As often said, the core subject matter of leadership or management is human beings. Here it is necessary to distinguish leadership from management. In general, management means the rational, objective, and logical administration of an organization, which focuses on target setting, task specification, and resource allocation, with emphasis on laws and stabilities [22]. However, leadership focuses more on the prospective, the ideas, and the persons, with emphasis on the individual's demands and goals, the embracement of revolutions and innovations [23].

[1] *Yongzhe Li contributed to the first four subsections of Sec. 3, however, requested non-co-authorship of this paper.*

While the success or failure of a company cannot be attributed to a single person, the qualities and decisions of the leading executives influence greatly on the final position of the company in the field. In our introductory case, Elon Musk and his leading committee's leadership changed Tesla's approach to the market and the business model. They have shown strong leadership in Tesla by battling the way to become an extraordinary company of electric vehicles that distinguishes itself from the traditional car industry. Tesla's stakeholders are inspired by a shared vision of building up the scheme of replacing traditional fossil fuels with new clean energy sources.

The ability to sell visions is of utmost importance when convincing funders and partners of the viability of the project. While the leadership can decide to continue or terminate a project, all decision makers answer to funders and partners. As stated in the Innovator's Solution [21], it is virtuous for corporate capital to be impatient of profits. In this regard, the long-term struggle for profitability of Tesla can be considered rebellious. Nevertheless, the credibility of the leadership in Tesla enabled the investment-intensive strategic vision of displacing fossil fuels.

Furthermore, the personal skills of the leadership through the involvement and supervision can modify the final product of the company. Through a correct supervision and involvement, the leadership can assign the resources efficiently and avoid resource waste. In the case of Elon Musk, he defined himself as a nano-manager, meaning that his involvement and supervision was complete on all parts of the projects, with an eager focus on the details. This supervision with high involvement yields an external feedback from the leadership, including the expertise of the leadership on different areas. On the other hand, the involved leadership can increase some delays due to unavailability or scheduling issues. As an example, instead of the original vision by Eberhard and Tarpenning of a high-performance electric car with only minor changes to the Lotus Elise's body, Musk wanted the car to be more luxurious and unique. He took part in designing decisions and was partly responsible for the overall delay of getting the end-product finished and shipped to the pre-order clients [12]. The highly participative management style of Musk is evident here.

3.2 Ecosystem

Defining and confining an ecosystem is ambiguous. In this paper, the ecosystem of an industry entails all the operations and operators related to creating and capturing the value. The ecosystem of each industry has an intrinsic equilibrium and each new company in the field needs to understand the conditions of the

ecosystem. An ecosystem is highly functional when there is a symbiosis between all the contributors and the ecosystem is able to constantly renew its functions.

In the case of the car industry, when Tesla was created, the ecosystem was a fragmented industry. There were providers for different car components and services for the distribution, selling, and maintenance of cars. In this situation, the large manufacturers assembled the cars and accumulated most of the value. Thus, in terms of mutual gain, the car industry ecosystem has been unbalanced, leaving it vulnerable to competitive ecosystems with new, more compelling monetizing models.

Tesla capitalized on this weakness. Instead of competing with the existing car manufacturers, they went aside and created a new ecosystem surrounding the electric car industry. This action resembles the concept of the Blue Ocean Strategy [24], where companies can thrive by creating "blue oceans" of uncontested market space instead of trying to outperform competitors in the "red oceans". This new ecosystem, while still closely related to the traditional car industry, had several new services for the consumer. For example, Tesla started the creation of a parallel energy distribution infrastructure in the form of charging stations for electricity. Thus, instead of waiting for other operators or government to design and built the infrastructure for the ecosystem, Tesla took the ruling position, controlling key factors in the field and any new company's dependence in the field.

Indeed, the establishment of an ecosystem is highly related to the grasp of the core technology. In the literature, the standard technology adopted by the industry is referred to as the dominant design [9]. When making analysis on Tesla's business model, the story of Fisker Automotive is worth mentioning. Fisker focused on manufacturing unique sport vehicles, and their first series production vehicle was a plug-in-hybrid model named Fisker Karma. However, Fisker's production was suspended due to a bankruptcy of its battery supplier [25]. Battery is inevitably one of the most important core technologies in an electric vehicle. Therefore, Tesla significantly invests in battery technology and has paired up with the battery manufacturer Panasonic, as mentioned in Section 2.2.2. The creation of the electric car ecosystem is not only an achievement of Tesla Motors but strongly influenced by the choice of the right partners during the settlement.

Unexpected news released in June 2014 informed about Tesla releasing all their patents. This action significantly surprised the whole car industry. After all, Tesla had already provided powertrain systems for numerous large car manufacturers, such as Toyota [26]. This strategy reminds us of the authorization from Google of the Android system. Despite that the strategy of Tesla seemed to damage its core interests, it actually was serving for the establishment of the Tesla ecosystem. The implementation of such a strategy would not only benefit

the promotion of a unified charging standard, but also would save Tesla's burden in building the charging stations. Furthermore, the expansion of the charging network would also be accelerated. Tesla has realized that only when electric vehicles are widely accepted all over the world, the company can benefit in full potential.

In addition, the significance of Tesla's ecosystem can be verified from the perspective of innovation management, comprising the process from ideas to products and the from research to markets. The success of Tesla proves the fact that innovations are not equivalent to creativity and ideas, but require a rigorous process to plan, evaluate, and supervise.

3.3 Superior Product

When entering a new industry, the advantage provided by a superior product yields an important edge against the natural competition in the field [27, 28]. With superiority, we refer to the perspective of the customer and the market. In this sense, superiority does not require quantitative or objective superiority but rather qualitative or subjective superiority.

The superior performance of a device with new technologies or innovative applications produces a disruptive breakthrough in the market [2]. A disruptive breakthrough is such that the market quickly adjusts to the related changes. However, the disruption yields a leading and controlling position to the disrupting company, as repositioning the product development requires time for the competitors. Examples of new technological market entries are the appearance of smartphones on the mobile phone market or hybrid cars on the car manufacturing industry. These disruptive processes can be successful (smartphones) or unsuccessful (hybrid cars) for different reasons. When the product released is clearly superior, the product takes over the market, with an associated control for the producing firm on the market. Such situation was clear upon the release of the iPhone 4, with a successful world-wide selling and further control of the mobile market until the appearance of a comparable competitor (Samsung). On the other hand, a different product with an innovative approach but no clear superior performance (e.g., a hybrid car) produces a less significant change in the industry and impacts little on the behavior of the consumers.

In the case of Tesla, it pursues high-grade and high-performance cars with emphasis on the considerations of fast acceleration and novel design solutions. These main attributions associated with Tesla products significantly differ from the traditional electric cars and most combustion engine cars. Tesla has conducted many technical innovations during the process of its development. Until July

2014, Tesla had issued in total 249 patents, among which 106 patents are related to battery, 16 are for motor, 30 for control, 21 for interface, 16 for detection, and another 7 for other technologies [29]. Instead of stating that Tesla is productive in core technologies, it may be more suitable to define Tesla's proficiency in technology integration. The most important core technology lies in the battery pack, including the power management and the whole configuration with the cooling system. The real breakthrough in battery technology, which finally resulted in an overwhelming advantage of over 400-km of range instead of a 100-km average range of other electric cars, provided Tesla with a competitive advantage.

Tesla has emphasized product philosophy and constantly optimized user experience. The company understands that the essence of the user experience is not just satisfying the requirements of customers, but also exceeding them. This results from the realization that an accurate customer analysis yields a low realization of the customer's own desires. Tesla has also showed that product branding is developed over a long period of time and the perception of the product is based on the previous experience and exposure. They consistently pursue excellent products with optimized user experience by developing user-friendly designs, e.g., the large touch panel and automatic software updates. Thus, in contrast to the traditional car ownership, where there is no manufacturer-customer communication after the purchase, Tesla owners perceive an improvement of the car specification through the updates. Consequently, the customers feel part of the Tesla community and improve the diffusion of the product in the market. As a result of the consistent product philosophy and constantly optimized user experience, the new Tesla Model 3 gained near 400,000 reservations during the first months after its unveiling.

3.4 High-end Customers

Depending on the definition of disruptive innovation, Tesla products may not be considered as disruptive innovations yet. On the other hand, the company has revolutionized the automotive industry. Conceptually, disruptive innovation contains creation of a new market and its value network for challenging the existing market and displacing its operations [2]. The significance of the social impact should also be considered [30]. A quick analysis of Tesla demonstrates that initially the target market of Tesla was affluent individuals. Extrapolating from the previous scheduled steps, the company plans to increase the customer volume by decreasing the cost of each car model, producing affordable products that can be considered by a large population as a viable transportation solution. With the achievement of the large production volume, the disruptive innovation require-

ments can be considered fulfilled, proving "crossing the chasm" [20] between the early adopters and early majority in the diffusion of innovations cycle [31].

Elon Musk changed the business plan of Tesla Motors, resulting in an aggressive expansive development process for Tesla. This process started with elitist cars that were sold only upon request [12]. This approach enabled testing the viability of the company, without the need for a strong infrastructure for continuous delivery. Concurrently, the company could settle and create a position in the market. During the settling period, the revenue from sales and external investments were dedicated in building the infrastructure and development of future products.

On the other hand, Tesla, or to be specific, Elon Musk succeeded in spreading their values to the public through different channels. For example, the release of the movie "Iron Man" in 2008 showcased the Tesla Roadster. The headlines related to Tesla and Elon Musk improved the company visibility over a long period of time. Another key point of Tesla's value spread is based on the invitation of many celebrities, politicians, film stars, and entrepreneurs for their selective first clients. The publicity gained through them triggered discussions in social media [12]. This approach corresponds to attaining the lead users in the diffusion of innovations theory [31].

Furthermore, with the careful early market positioning, Tesla and Elon Musk still found a method to avoid the attention of the traditional car manufacturers. They marketed themselves as a clean technology and environmentally friendly company. This approach, in the eyes of traditional car manufacturers, meant a small market section of environmentally conscious customers, far from reducing any revenue or presenting any risk for their business. Besides, they went for the elitist sport-car market, setting themselves only a very few car manufacturers as potential direct competitors, such as Ferrari. The combination of these two factors let Tesla to establish its own uncontested market space, creating the new "blue ocean" [24] (see also Section 3.2).

3.5 Adaptation to the New Market

The disruptive process and consequent transformation of an industry produces a distorted situation in the industry or, in some extreme cases, the scission of the new transformed industry from the traditional field it originated from. This distorted situation is unregulated by the previous traditions and provider chains, applied before the disruption. For example, in the introductory case of Tesla Motors, the disruptive move resulted in an industry with reduced amount of subsidiaries and outsourcing. In these situations, the capability of the industry to satisfy the customer requirements and settle a controlling position becomes

of high importance. Generally, once the disruption finishes, the first business to scale up gains control over the field [32]. Furthermore, for this actor, the concept of the ecosystem is crucial. The disruption and further change in the industry will create different dependencies and chains, therefore, producing a completely different ecosystem (see Section 3.2 for further information on ecosystems).

The large companies that controlled the previous ecosystem have the same situation compared to any small company in the sector, meaning that the control of the new ecosystem will be challenged. The new focus and quick change in the business for each company can favor a smaller company with a higher flexibility [33]. This quick reaction of a small company provides a crucial advantage to settle and start attracting the customers. Moreover, this advantage can be used to set the rules and traditions that differentiate and strengthen the advantage of this small company. These new rules have to be clearly stated in the form of goals, e.g., controlling the distribution of a necessary product in the new ecosystem. Returning to the introductory case, Tesla's founders Marc Tarpenning and Martin Eberhard planned Tesla's strategy in the long term [12]. This long-term plan ensured that, upon the disruption, Tesla reacted quickly with well-defined goals, such as the control of the battery production and the control and standardization of the charging system. These two simple goals with a clear definition and a quick development consolidated the advantage gained by the first disruptive move. The further scaling of the company and initial outsourcing to competitors set all of them in a secondary position, tied to the standardized measures of Tesla and, up to an extent, dependent on the controlling entity, Tesla.

The effectiveness of the Tesla's long-term strategy is supported by the number of launched electric vehicle models in the recent years. From a handful of models available just a few years ago, there are now dozens of models to choose from and future releases have been planned. Though there have been significant sales by the pure-electric car Nissan Leaf, Tesla Model S was the car that changed the public opinion about electric cars and made them attractable in the eyes of customers.

The long-term strategy is also crucial from the sustainable competitive advantage point of view. Tesla will find it difficult to compete in the mass produced electric car market, especially as their lower-end offering, Model 3, will be on the market much later than competing products, such as Chevrolet Volt, Opel Ampera-e, and Renault Zoe. Moreover, most electric cars sold in China are also locally manufactured in collaboration with traditional car manufacturers, such as Daimler AG, and might constitute over half of total EVs sold worldwide already at the end of 2016 [34, 35]. Therefore, Tesla is presumably on the right path, building the ecosystem and being a technology company instead of a plain car manufacturer.

3.6 Summary of the Approach

The previously explained factors during Section 3 yield some important elements to consider in industries on the verge of an unforeseen transition. Often, introducing the advanced technology to the market is insufficient by itself. Rather, the theory of disruptive innovations by Christensen [2] suggests that a novel combination of elements related to the business strategy leads to disruptive innovations. Figure 5 depicts the idea that the correct application of this disruptive method will strengthen the overtaking of a new ecosystem created by the disruption.

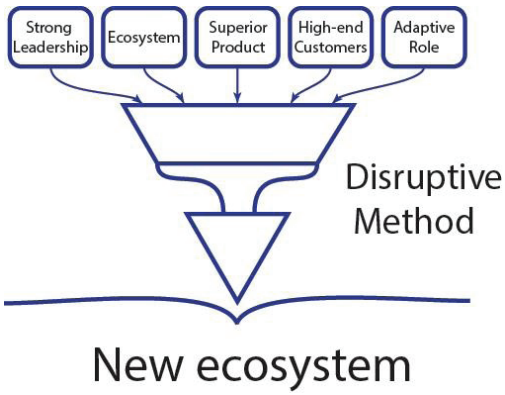


Fig. 5. *The Tesla approach.*

In the literature, Tesla's high-end market entry strategy has already been discussed as a model for other new emerging technologies in the automotive industry [36]. As explained above, we consider the Tesla approach to comprise multiple components. Next, we apply these extended learnings from Tesla also to other industries.

4 Application of the Tesla Approach to Other Industries

This section introduces case samples of industries that have gone through a recent transition or can be expected to be volatile in the near future. Interestingly, the case studies also have the potential to affect the automotive industry through innovations or be affected by the changes in the car industry. This is a clear example of the vastness of modern ecosystems, and on the other hand, illustrates that many profounding innovations that disrupt the industry actually originate from outside of the traditional players in the industry.

4.1 Case Scenario: Finnish Biofuel Industry

The depletion of conventional petroleum reserves is one of the pressing global issues. Another issue is the continuous increase in greenhouse gas (GHG) emissions that relate to growing energy demand. Transport fuels are a significant polluter and, therefore, seen as a potential CO2 reduction subject. Due to being more environmentally friendly, biofuels can reduce carbon dioxide emissions by approximately 60% compared to fossil fuels. Therefore, the routes for conversion of renewable materials are being developed aiming to produce biofuels. [37, 38]

The European biofuels market is strongly supported by regulation. The EU aims to reduce carbon dioxide emissions from road transports by requiring that a 10% share of all fuels consumed must be produced from renewable sources by 2020 [37]. Finland is a forerunner in EU legislation and has implemented higher blending mandate and a preferential tax regime for biofuels: 1) a 20% biofuel blending mandate in all transport fuels by 2020, and 2) incremented target of 40% by 2030 [38, 39].

4.1.1 Market Overview of Biofuels in Finland

Annual diesel demand growth in Europe and Finland has been historically 2.6% and 1.5%, respectively – in 2020 total biodiesel demand in Europe is expected to reach 22 Mtons annually [40, 41]. The gradual rise of biofuel blending in Finland is expected to result in a market of 170 ktons of 1st generation and 160 ktons of 2nd generation biodiesel in 2020, satisfying the 20% energy share of the total fuel consumed. Although penetration of electric and hybrid vehicles will likely cause some decrease on diesel demand, it is still estimated to remain stable [42]. However, faster rates of petroleum displacement by electric transportation have been also visioned [43].

Current production of biofuels in Europe is mainly 1st generation (biofuels made from the sugars, vegetable oils, or animal fat) with the exception of Finland, where, for example, Neste Corporation produces approximately half of its renewable biodiesel from waste residues, such as agricultural residues or industry waste (thus 2nd generation biodiesel) and UPM, a biotechnology and forest industry company, produces 2nd generation biodiesel from tall oil [44].

In 2020s, the target of the Finnish government is to increase the total share of sustainable and renewable energy to over 50%. In transports, the share of renewable energy should reach 40% in 2030s. From the study of the 2030 EU climate targets, the most efficient way to reduce emissions in Finland is to develop drop-in biofuels because they can be used directly in the current engines without any changes. Therefore, no further infrastructure building is needed. Other biofuels, e.g., biogas,

or electric cars are also valid options. However, they need further investments in infrastructure. Under the protection of government regulations, biofuels have the opportunity to enter the market and replace the traditional petroleum based fuels, which have an aggressive ecosystem towards disruptive innovations.

The higher blending mandates drive biodiesel industry in Finland. Figure 6 shows that the implementation of a 20% blending mandate by 2020 results in a 85% growth in biodiesel demand. Further development in biodiesel volumes by 2030 derives from a higher blending mandate of 40% by 2030. Due to the limitations on 1st generation biodiesel, the 2nd generation will account for the whole increase in demand caused by the higher blending mandate. This results in an annual demand of 430 ktons of 2nd generation biodiesel. [40, 41]

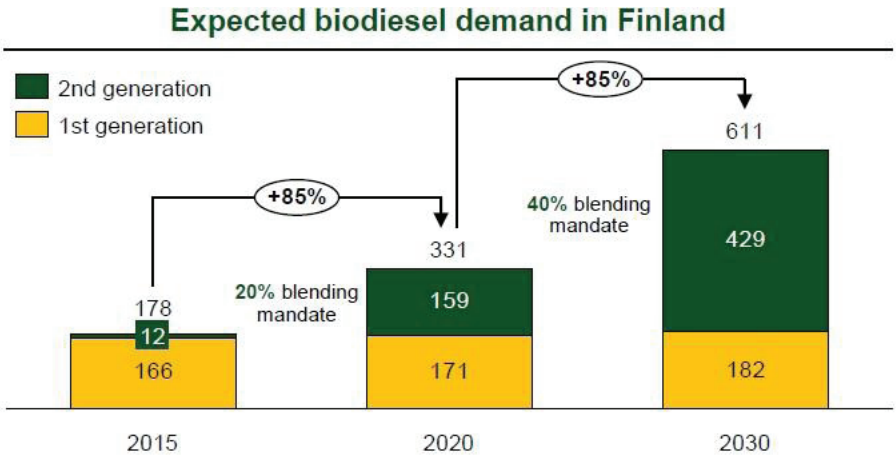


Fig. 6. *Expected biodiesel demand in Finland.*

4.1.2 Applying the Tesla Approach

The disruption in the car industry caused by Tesla Motors was contributed by many factors presented in Section 3. In this section, we will discuss the application of the Tesla approach in the biofuel industry, which is undergoing a complex transition alongside with the transportation fuel industry.

Strong Leadership

There are many companies in Finland which are technology leaders in their own specific segment of biofuel production. An example of strong leadership is found in Neste Corporation. Neste was originally founded in Finland in 1948 to ensure the availability of refined petroleum products. In recent years, due to the environmental issues and government regulations, biofuels have become a future trend.

Already in the 1990s, Neste Oil started to investigate diesel fuel based on renewable raw materials, and in the late 2000s, the research and development project turned into a business activity [45]. The early products involved a high ratio of crude palm oil, which was criticized due to its production substituting large areas of natural rainforests. With quick reaction, the ratio of crude palm oil in the renewable raw materials used by Neste was already reduced to 31% by 2015. The foresight of Neste about the future and the keen sensitivity to the market and environmental concerns enabled them to quickly shift from petroleum products to renewable diesel with high-utilization ratio of waste. In 2015, Neste Oil changed its name to Neste, due to the successful transition of utilizing renewable feedstocks to produce biofuels. In 2016, Neste is the leading global renewable diesel oil manufacturer with an annual production capacity of two million tons (2000 kton), enough to satisfy the 2030 Finnish regulation mandate (430 kton) [46]. In the case of Neste, strong leadership continues to play an important role in the future development direction of the company during the times of transition and uncertainty.

Ecosystem

The ecosystem of the biofuel industry is composed of raw biomaterial providers, research organizations, equipment and facility suppliers, biofuel distributors and suppliers of biofuel-driven vehicles (Figure 7). In the current situation, most of the bioethanol (1st gen) is produced from food resources, e.g., starch, which have to compete with global food production. Since many countries are still suffering from starvation, biofuels based on non-food feedstocks, such as straw and manure, are thus worth promoting.

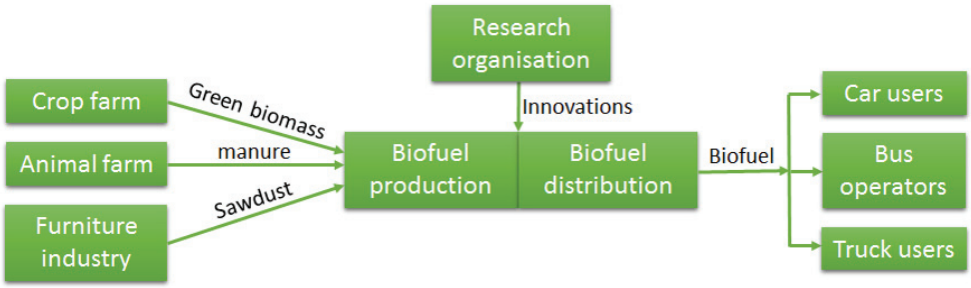


Fig. 7. *Example of a biofuel ecosystem.*

To build the ecosystem of biofuels, the integration of different industries that are not traditionally connected to biofuel production, such as transportation, agriculture, waste management, green vehicles, and other relevant business, is required. This collaboration and transparency in operations could be built on lean methods.

The most consumed biofuel in Finland is ethanol, and it is distributed through the blends of E5 and E10, referring to 5 and 10% ethanol ratios in petrol. The consumption of pure biofuels is, however, low [47]. Therefore, another critical issue is that the potential stakeholders are required to make certain investments, such as biofuel-driven vehicles and biofuel distribution infrastructure, to accelerate the growth of the ecosystem. Finland has not been very active on promoting the consumption of pure biofuels. The national policy instruments could set regulations to increase the market share of biofuels, consequently increasing the attractiveness of the industry for investors. The government and municipality operated or otherwise regulated vehicles, such as busses or waste management trucks, could be required to use pure- or high-blend biofuels.

For the long-term options, the most potential biofuels in Finland are biodiesel and ethanol. Biodiesel is mainly used as a blending component in diesel. However, only minor modifications or even no modifications to the engine are required to use neat biodiesel. Therefore, biodiesel is still a good option for the future biofuels development. The utilization of high-concentration ethanol requires special engine technology found in flexible fuel vehicles (FFV). Typically, a blend of 85% of ethanol and 15% of gasoline (E85) is used in the FFV cars [48]. Promoting FFV cars could significantly broaden the ethanol market.

Superior Product

In the Tesla approach, having a superior product is one of the key factors to enter a stabilized market. In the biofuel industry, government research supports encourage ambitious research and development targets for startups and large corporations. In order to significantly impact the conventional fuel usage and distribution ecosystem, disruptive innovations need to be developed to produce drop-in biofuels which are similar to traditional petroleum products and can be dropped directly into the currently existing fuel distribution system and used in today's engines without any changes. Different to ethanol, the drop-in biofuels could directly replace petroleum-based gasoline, diesel, and jet fuels without massive infrastructure investment. The most significant advantage of drop-in biofuels is that it will enter the market much faster than other biofuels and with a much lower cost.

High-end Customers

To avoid the direct competition with the traditional petroleum industry, biofuel industry should seek for high-end customers, such as aviation industry, racing, and public transport. This would also increase the recognition for biofuels in the eyes of the general public. Back in 2010, the fuel supplied for Scuderia Ferrari by Shell in Formula One contained an advanced biofuel component derived from cellulosic ethanol,

an advanced biofuel made from straw. In 2014, SkyNRG Nordic provided a mixture of biofuels to the airline company Finnair. This environmentally sustainable biofuel was applied in a flight from Helsinki to New York [49]. Further, in 2015, Neste Corporation and Boeing promoted and accelerated the commercialization of a renewable aviation fuel. The public transportation is also a good option for biofuels, since the government could play a role on the regulations to increase the share of biofuels.

Adaptation to the market

A strong transition towards biofuels is already in process due to strong support policies. However, the increasing trend still depends heavily on the regulation and leaves the industry vulnerable to a number of changes. Therefore, the biofuel industry needs to consider multiple future scenarios and a set of corresponding actions to sustain a successful business. Table 1 introduces examples of future threats to the industry and our suggestions to adapt to these changes.

Table 1. *A view of risks and possible mitigation actions in the biofuel industry.*

Category	Description of key risks	Mitigating actions
Political risks	• Changes in the EU legislation, since the biodiesel market in Europe is artificially created by regulation • Lowering/removing blending penalties and/or tax incentives might have significant impact in either the output price or volumes	• Awareness and timely actions regarding new initiatives with adequate resources • Establishment of good relations with key political decision-makers • Public opinion building
Economic risks	• Competitive situation with new market entrants in 2nd generation biodiesel • Output and feedstock price fluctuations can temporarily weaken profitability margins and thus cause lower financial returns • High downstream customer power is a considerable risk, especially if the market consolidates even further	• Respond to intensified competitive situation by aiming to achieve minimum market threshold for biodiesel volume to gain producer power • Output and feedstock price fluctuations are mitigated with long-term supply contracts
Technological risks	• 1st and 3rd generation biodiesel can alter the current market for 2nd generation biodiesel by potentially becoming cheaper to produce or more viable in the long term	• Maintaining a state-of-the-art 2nd generation biodiesel development while also maintaining a suitable strategy for alternative technologies • High technological expertise within the company is vital
Disruptive risk	• Adapting to high displacement of internal combustion engine cars by electric cars	• Biofuel production in connection with a power plant • Electricity production from biofuels or straight for biomass

4.1.3 Discussion

Recently, a series of support policies are introduced to promote the development of electric vehicles in the EU. Electric vehicles are widely recognized as the future to solve energy security and play an important role in low-carbon transport systems. However, in the next 20 years, liquid fuels continue to be a major contributor to vehicle fuel consumption and GHG emissions, especially in developing countries. The application of biofuels to transport systems should be fully taken into account in the formulation of policies and strategies for vehicle fuel support. For example, 2nd generation biofuels have the reduction potential of more than 60% GHG emissions. Therefore, the EU fiscal policy should encourage the support of biofuels development.

From the technological point of view, because of significantly higher conversion efficiency, pure electric vehicles could have more advantages in the energy consumption and GHG emissions than combustion engines burning biofuels. However, this necessitates low-carbon power generation mixture. Overall, the vehicle fuel diversification, i.e., multi-technology coordinated development should be promoted in order to reduce the average carbon intensity of vehicle fuel and GHG emissions. In Finland, the large transport fuel distributors, such as Neste and St1, should more openly support also the electric cars by offering more charging capacity to electric vehicles. At the moment, they only highly promote the availability and use of biofuels.

As discussed before, Finland is leading in multiple sectors in the field of biofuel production. In addition, Finland is strongly focusing on cleantech. However, the automotive companies have their main operations outside Finland (both internal combustion and alternative fuel vehicles, including electric). A discussion about Finland's contribution to eco-friendly transportation is needed. By 2016, the contributions are mainly revolving around cold-resistive electric busses and concepts of variable compression ratio engine systems. Even though modern manufacturing is highly automatized and Finland has one of the lowest price for electricity, the consumer based production is low. By active participation also in the development and manufacturing of the engines that utilize high-tech Finnish fuels, Finnish companies could advance for a leading position in the disrupted biofuel ecosystem.

4.2 Case Scenario: Personal Electronics

In recent years, the demand for communication services, such as Facebook, Skype and Snapchat, has been increasing. Additionally, the machines and appliances around our society are networking, increasing the connectivity demand

and trending this feature in recent appliances. Therefore, the amount of data transmitted, analyzed, and stored is immense. In this section, we focus on innovative applications that can monitor, transmit, and analyze content related to the user in interactive means. These new devices, also referred to as gadgets, employ enhanced communication capabilities to perform most of the services in a virtualized environment, while the device serves as a portable interface. The market potential of the field is expected to leap in the future with the promise of ultra-high speed 5G mobile connectivity [50].

In particular, we examine smart wrist wearable technology. In previous years, the wearable devices, such as Apple Watch and Samsung Gear, have been interfaced through the mobile phone, supporting on the phone processing power. With the improved connectivity features, this processing can be outsourced to an external server utilizing a virtualized computing environment, i.e., the cloud. When employing the cloud computing in the field of smart wearables, the end device acts as the input/output channel.

Cloud computing in general has been proposed as a future information technology solution [51, 52]. Different implementations of cloud computing describe its potential, including Infrastructure as a Service (IaaS), Software as a Service (SaaS) and Platform as a Service (PaaS). These implementations use the cloud for the operations in different ways: IaaS is the most general approach where the user is constantly connected to the cloud and all the computing capabilities are virtual. On the other hand, SaaS and PaaS use a reduced dependence on the cloud where either an application provides the content (SaaS) or the user has available a certain content, provided by a virtual platform in the cloud (PaaS) [52]. All these implementations are usually denominated as Internet of Things (IoT) from the general point of view. IoT conveys all the future concepts of communication technology, available with the ultra-fast mobile communication, such as monitoring services.

4.2.1 Market Overview in Personal Electronics

Personal electronics, described here as small devices with high communication capabilities, have a huge potential as an innovative, disruptive application [53-56]. For example, smartwatches were the first wearable technology to be introduced into the market. The versatility and clarity to provide information to the user quickly gained acceptance, and the market for these accessories grew quickly. A study on 2013 projected the market size of smartwatches to grow by over 400% in the next four years (2016-2020), from 80 to 373 million units sold per year (Figure 8) [53].

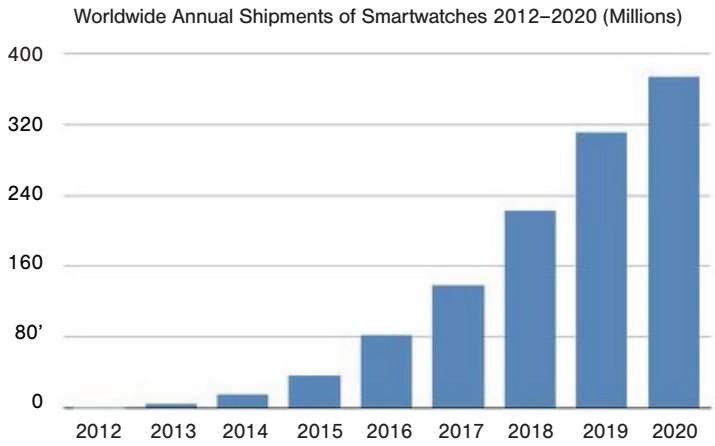


Fig. 8. *Estimation of smartwatch sales in the future years (in million units) [53].*

The consumer acceptance of smartwatches has been studied considering different perspectives, such as social acceptance of the technology or the device technical specifications. The major individual concerns correspond to the device reliability, demonstrability of promised characteristics, and enjoyment of the device. The common acceptance differentiation in all these concerns was on age, more specifically, reducing acceptance in all cases with age [57].

There are also other hindrances besides adoption by elderly customers. The dependence of the smartwatches to have a constant connection to the mobile phone, which provides and process all the information, limits the capabilities of these terminals. This limitation, along with technical limitations such as the battery life, has reduced the projected growth of the market, with an updated estimation (on 2016) for 2020 of about 200 million units sold per year [54, 55]. This contradictory information is explained by consumer adoption of the available product. While the current smartwatches yield an advantage in information sharing and upgraded functionality, the forecasted improved capabilities (not available yet) are holding the market back [55, 56]. Moreover, the reduced size, comparable to a mechanical watch, increases the limitation for input/output of information through the integrated screen [56]. Finally, the product cost limits the market.

Further advances in technology are addressing many of these important limitations. Battery life could be extended via energy harvesting from hand movement, clothing, or accessories, e.g., umbrellas (ZON Powersol) or running shoes (SolePower), that can be used to charge devices with a battery. With innovative input methods, such as voice recognition or gesturing, the limited in-

put functionalities can be circumvented. In addition, the reduction in size and, more importantly, the adequate location and constant contact with the skin are major advantages for this technology over the mobile phones, considering all the processing and capabilities are compatible [56]. The precise location on the wrist, enabled by the the small size, improves activity recognition based on, e.g., the accelerometer. Furthermore, the device can also receive data from the contact with the user, e.g., heart rate, blood pressure, or body temperature [57]**.** More specific devices for personal monitoring, available on the market, address the positioning and skin contact advantages but are shortcoming the previously described benefits shared with the mobile technology: information, processing, and communication.

Apart from the smartwatches, different devices are under development comprehending wearable displays, similar to Google Glass, or the implementation of the technology into textile. With these innovations, the communication based personal electronics will gain more degrees of freedom, such as health monitoring or drug delivery [58].

Strong competition among the mobile phone industry indicates the interest for controlling the emerging ecosystem. After the closure of the Google Glass project, Apple (a direct competitor) revealed a similar project for an augmented reality device while Microsoft has under development a similar device, the Hololens. These three projects on a very similar product reveal the high interest of the leaders in this ecosystem (mobile phone technology) in taking the advantage of the first mover to the new field [32].

Finally, the created market will require a strong infrastructure to suffice the consumer demand. This demand and the increase in cloud computing will reduce the local operations in favor of large computing centers. While this increase in computing centers will produce a relative increase of maintenance, the most important part of these centers is to guarantee data security and safety [59].

4.2.2 Applying the Tesla Approach

The previously introduced rising market of smartwatches yields a clearly prepared industry in the verge of a technological transition, very similar to the introductory case (Tesla Motors) during the first steps of their development. Comparing the emerging industry with the points described in Section 3, common factors can be visualized.

Strong Leadership

The ecosystem presented here is under development and no controlling entity

has yet appeared. The leading mobile technology companies are the first ones to invest in the transition towards the personal electronics field, with a starting step on the smartwatches. The early devices released into the market were received with caution, due to the shortcomings in usability. Moreover, this also changed the customers' expectations and diminished enthusiasm of the future products.

Due to a fierce competition between the leading technological companies combined with the early stage of the field, the initial devices lacked technological differentiation from the mobile phone ecosystem. Thus, the controlling companies of the mobile phone ecosystem are leading this transition. However, the presented potential with advanced communication technology demonstrates the capability for a single company to disrupt this ecosystem.

The disruptive company has to clearly differentiate itself and lead the standardization of the devices and a normalization of the information transfer. Furthermore, the different possibilities that derive from the personal technologies can develop into different ecosystems, in a more consumer-oriented fashion.

Ecosystem

The smartwatch technology can clearly create its own ecosystem (see Section 3.2) separated from the mobile phone industry. A depiction of the ecosystem is presented in Figure 9. When fully developed and independent from mobile phones, the devices are sufficiently distinctive to be able to create a separated provider chain, including server technology and systems required for efficient communication. Firstly, new subcontracting chains could be created for the manufacturing of specialized parts, such as connectors, antennas, or sensors, for the final device. Secondly, the cloud computing applied in this ecosystem allows for the quick escalation of the service independently of the location, benefiting from the fast communication technology. Finally, this communication is not limited to one technology such as 5G but could operate in diverse frequencies, e.g., utilizing the Things Network or Sigfox, depending on the type of data transmitted between the device and the cloud.

On the other hand, the client base of this industry cannot be compared to that of other electronics due to the distinct products offered. The certain similarity at this early stage with the mobile technology cannot be extrapolated to the situation of a full developed ecosystem. For example, various applications which require stronger processing and higher communication capabilities, pass the mobile phone technology. Furthermore, innovative services can be included in this new ecosystem, e.g., wirelessly charging or personalized information based on location.

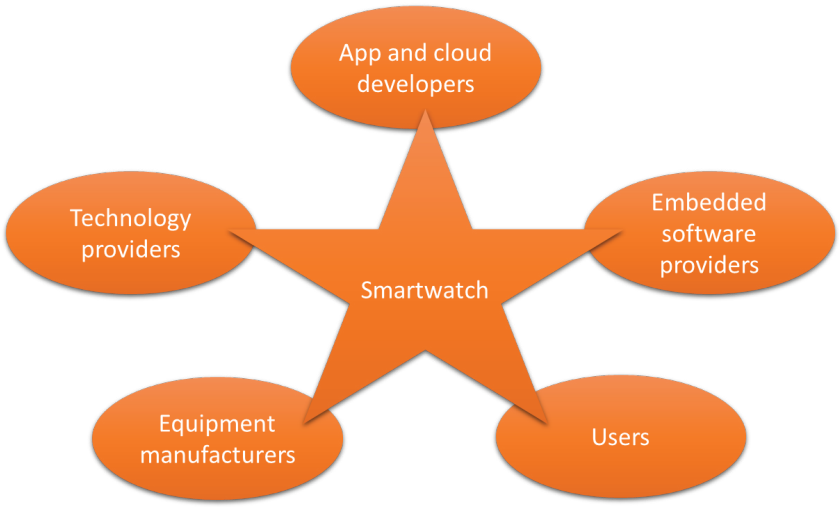


Fig. 9. *Ecosystem of smartwatches.*

Superior Product & High-end Customers

The miniaturization and increase of capabilities of the future smartwatches compared to the available mobile phones yields a direct superior product (see Section 3.3). At the moment, the existing comparable products, such as smartwatches or mobile phone accessories, have reduced capabilities in computational power and communication, limited by the complemented phone.

On the other hand, the approach to the market, as with many other high-technology introductions, has an increased success rate with the high-end customers. The pioneers and technology customers, ready to pay a high price for a new technology, yield important advantages in the market settlement, corresponding to the elitist car buyers in the Tesla case. Furthermore, the confined market segmentation also suits well for startups and other newcomers with limited resources, especially related to the production.

To compete with smartphones, smartwatches must have unique features or functions compared to smartphones. On this side, the position of smartwatches, directly worn on people's wrist, enables measuring heart rate and body temperature. Therefore, some apps related to fitness and healthcare have already been developed and incorporated. Voice recognition techniques would be essential for smartwatches to improve information input.

Adaptation to the New Market

Finally, the small companies comprehending (or creating in) this new industry possess the reaction capability and small inertia necessary to operate in a trans-

forming industry. Here, the customer oriented approach can define the controlling entity due to a higher satisfaction, critical for the long-term success in the field of personal electronics.

4.2.3 Discussion

The previously introduced smartwatch industry relies strongly in the advancements in communication technology. This major disadvantage reduces the commercialization of the devices and creates a negative customer feedback, as the customers have to wait for technological advancements and promised future features. These new features benefit from the advanced communication as well as cloud computing, overcoming the mobile phone capabilities.

Finland is a leading candidate in this area with a long tradition of high quality IT and communication network research, innovation, and commercialization. Promising initiatives from Polar and Suunto represent the Finnish potential with a limited production of smart wearables. However, Finland requires development in mass production after Nokia's regress. Currently, the international competitors, such as Apple or Samsung, have a stronger manufacturing infrastructure for a competitive position in the industry in comparison to Finnish companies.

On the other hand, this rising industry is closely related to the connected services of smart transportation described in section 2.3.2. The advances in smart transportation require fast communication for the correct synchronization of the vehicles and will benefit from cloud computing, reducing the processing costs in each individual vehicle. The Finnish government is strongly supporting the creation of a MaaS platform through the agency Tekes (See section 2.3.2). The combination of the smart transportation platform with the integrated services of smartwatches can create improved user-experience and a larger ecosystem. The personalization of the services due to the personal electronics in their different form will extrapolate to the rest of the services, such as the smart transportation.

Due to all these combinations and new scenarios, not available in the modern legislation, governmental development is required for the standardization of the communications and data management. The value creation in this new ecosystem will be related to the data analysis, similar to the value creation for modern technological companies, such as Google. Important issues, such as data privatization, need regulation in the future ecosystem created around personal electronics and smart transportation.

5 Conclusions

From a philosophical point of view, the emergence of any thing has its inevitable reaction. Social development is facing various emerging environmental issues, such as smog and land desertification. One of the consequent reactions is to develop new solutions for sources of energy. Vehicles propelled with new energy sources is the future development trend of the car industry. However, which one will win in the history of choice; pure electric, hybrid, or fuel cell vehicles; we cannot make the announcement. Nonetheless, one thing is certain. The development of technology is a profound process. If anyone wants to build their own mirages through pure fantasy, there is only result, that is, the elimination by history. Nevertheless, a strong vision supported by a well-planned strategy and a capable team is a powerful tool in creating new businesses. The present work contributed to the existing knowledge of successful business models and their application.

The analysis of the development of a successful company (Tesla) from its roots to the internationalization and settlement provides important factors that strengthened the company's position in the newly created ecosystem. Previous initiations on the automotive industry were mostly unsuccessful due to the hostile and aggressive competitive actions from the controlling parties. The comparative development of Tesla over these previous initiation attempts indicates a stronger position and avoidance of the competition from the beginning. As a part of the disruptive method that astounded the existing automobile ecosystem, five factors increased Tesla's advantage over its competitors: strong leadership, ecosystem, superior product, high-end customers, and adaptation to the transformed market.

First, strong leadership is not only related to management from the leading committee but to the assigning of resources and a clear objective. The management of Tesla Motors designed the business plan to avoid the fierce competition while focusing on the main assets of the ecosystem to be created. Second, this new ecosystem differentiates the provider chain and creates a different dependence than the previously established one. Furthermore, the ecosystem eventually differentiates the market, diminishing the competition. Third, a superior product is introduced to break and disrupt the market. This superior product can be judged either based on measurable performance or the user experience. For example, a product that is perceived superior by the customer has a larger impact in the market than their counterparts even if they provide similar performance. Fourth, the introduction of the product to the market benefits from a high-end market approach. This approach enables limited at-

tention from the competitors while providing a customer base. In the case of Tesla, the traditional conception of electric cars being only for eco-friendly customers instead of the general public was also an advantage. Finally, the flexibility and fast adaptation to the new market created after the disruption secures the controlling position for the company.

These factors are extrapolated and their application is explored in other industries with two case scenarios: biofuels and personal electronics. The situation of both industries, rising and in the edge of a technological transition, resembles the automotive industry when Tesla was created.

In the case of biofuels, it commits to a strong potential for quick development in the market and further increase of revenue. Recent years have witnessed the first steps towards a bio-based economy. However, cost-efficient use of bio-based materials in highly-integrated biorefinery facilities are required to ensure competitiveness and stability in the long run. Research efforts in the field of biofuels have already brought commercial possibilities to help realizing this ambition. The challenges related to the utilization of biofuels involve: 1) the strong and aggressive competition by the traditional oil industry, suppressing any company to develop into a high production point; 2) changes in the ambition to support certain renewable energy sources; and 3) changes in the EU's stance towards biofuels. The results presented here support the potential of a strong company in the field of biofuels displacing the traditional fuel industry.

On the other hand, the field of mobile technology is developing quickly, releasing new products and highly benefiting from miniaturization. Smartwatch devices and personal electronics derive from this research and hold a potential to disrupt the mobile technology ecosystem. The available models of smartwatches possess an intrinsic limitation by the connected phone which would be overcome by the fast communication and cloud computing. The combination of communication and cloud computing yields a low performance requirement on the device, serving as an affordable terminal to access information and services. Similarly, the future of smart transportation requires fast communication and cloud computing, having a potential to join both ecosystems into a general communication-based ecosystem. This new ecosystem provides a value creation similar to that used by Google or other companies in advanced technology, requiring new legislation to improve the quality of services and control the data management.

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Changing Hats: From Academics to Entrepreneurs

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ABSTRACT. *The conventional view of academia and universities has changed much since the beginning of 21st century in every aspect, including the role of professors, teachers, researchers, students and other staffs. With the increased pace of development, the world needed a renewed system of education which can incorporate the ever-changing requirements of the society. In this article, we have narrowed this "change" to the case of doctoral students. When it comes to career choice, doctors had to compromise to a great extend in recent years, as the opportunities they have in the academia and the industry are shrinking over time. One of the outcomes of this scenario is the new platform of academic entrepreneurship. We are analyzing the nature and current trends in academic entrepreneurship by studying different universities around the globe and a deep analysis of our institution, Aalto University, Finland. The support offered by universities for doctoral students is the main focus of our study. Through literature reviews, interviews, a survey and internet based research, we have attained remarkable findings on academic entrepreneurship. Finally, some ideas and suggestions from our side which could boost up the entrepreneurship fostering capability of universities.*

KEYWORDS: *Academic entrepreneurship, doctoral education, universities*

1 Introduction

An individual's decision on becoming an entrepreneur is the result of a personal decision making process, where one assesses the opportunities, their cost and the risk-reward relationships [1]. Traditionally, wearing a hat at the graduation ceremony symbolizes that a person has achieved a degree in a specific field. However, recent graduates, especially doctoral graduates, have deviated from the traditional path in the academic life, where a person is expected to continue its research activity after obtaining a doctoral degree either in academia or industry. What is observed in the marketplace nowadays is recent doctors changing their doctor hats for entrepreneur ones. There are several factors which contribute to this transition from academic to entrepreneurial careers. Perhaps the most direct one is the unbalance between the number of doctoral graduates and the number of available positions as a researcher (ex. Post-doc researcher, assistant professor). The increasing competition among students has forced doctoral candidates to build an extensive publication record and capabilities – traditionally this is known as the 'publish or perish' culture. With an increase in the competition, doctoral candidates have a hard time securing their positions in a university and/or receiving funding for their research. Also, recent graduates prefer to apply for positions outside academia. During doctoral studies, candidates develop their skillset in both field-specific and more general areas such as writing, data analysis and collection, teamwork and communication, which qualify them for assuming a position in the industry. Another option for recent doctors after getting their degree is entrepreneurship. Doctoral candidates dedicate at least four years in a specific area of research. This makes them suitable for solving problems and contributing back based on the generated knowledge. However, few doctoral programs are preparing students for a career outside academia. Consequently, recent doctors are being challenged to build a business based on the learning from the academic path. In order to do that, these professionals are required to learn about entrepreneurship 'on the job'.

More specifically, we present an in-depth study on Aalto University, where we discuss how the university is fostering entrepreneurship. In addition to that, we have organized a survey among doctoral students from different schools in order to understand how aware they are regarding the university's support structure and their intentions regarding entrepreneurship. To expand and generate a base for comparison, we also reviewed how other universities around the world are supporting entrepreneurship for their doctoral students. Our study discusses the necessity of preparing doctoral students for a 'non-traditional' career – in other words, moving from academia to entrepreneurship.

”Everyone who can face up to decision making can learn to be an entrepreneur and to behave entrepreneurially”, and that entrepreneurship is “behaviour rather than personality trait” [2]. Doctoral students possess deep expertise and skillsets compared to the general mass of masters, undergraduate or other category of students. They are focused on potential core ideas of business. A period of 3 to 4 years provides the necessary time for developing research and expertise in a specific topic which can lead to a business idea. Besides, opportunities for international networking with experts in the area they are specializing in, through conferences and other kind of events, is an excellent platform to widen the reach and popularity of their work. Despite all these advantages, there are some key elements that doctoral students lack, which are mostly business skills, access to business networks and an entrepreneurial mind-set. Hence, preparing doctoral students with the skills that they lack is of high importance.

If we consider the current entrepreneurship scene or specifically the web based ventures, there are several “fart-apps” that have come out because of a bulk approach. The term “fart-apps” implies those applications or services which are useless and overpriced, though people are still using them. The name was originated from a mobile application which does nothing more than flatulence sounds. At this juncture, the relevance of science based or research based entrepreneurship ventures has become a necessity for the society in order to build a culture comprising of people with refined knowledge and senses. One example of such research based entrepreneurship is Canatu, Helsinki, which is a spin-off from Aalto University who makes thin conductive films for touch applications. This endeavor would not have been a reality without university support. It is true that there are noteworthy businesses coming out of general student bodies, for example Mark Zuckerberg with Facebook or Bill Gates with Microsoft. With much smaller student body, the doctoral education has also produced gems like Sergey Brin and Larry Page with their company Alphabet, or more commonly known as Google.

2 Academic Entrepreneurship: Its relevance and a Literature Survey

Entrepreneurs take on personal and financial risks to start a business for its potential success. At the same time, they expose themselves to uncertainty, failure and frustration, all associated with the business owning process [3]. Entrepreneurship was recognized as an important factor for socio-economic prosperity [4]. The study of entrepreneurship in the university setting is becoming increas-

ingly important. Academic entrepreneurship entails the use of research-based innovation into the commercialization of goods and services.

Several factors have been identified as being potentially important in entrepreneurial activities such as economic values, family background, gender, education, previous employment and previous entrepreneurial experience [5]. Numerous models aimed at explaining the motivation behind choosing a career in entrepreneurship have been developed in the literature. Segal et al. proposed a model for entrepreneurship motivation. It was noted that self-employment desirability, tolerance for risk and perceived feasibility were the three factors that significantly predict self-employment intentions. The presence of all these factors was identified to lead in to a stronger intention of becoming an entrepreneur. Gilad and Levine proposed a "two-interacting" model for entrepreneurial activities called the "push-pull" theory [6]. The "push" theory refers to the negative external forces that influence individuals to become an entrepreneur. Among these, job dissatisfaction, difficulty in finding employment, insufficient salary or tight work schedule can be mentioned. The "pull" theory refers to internal factors that influence individuals to become entrepreneurs. Among these, desirability of being involved in entrepreneurial activities, seeking independence, self-fulfillment, wealth and other desirable outcomes, can be mentioned. S. Wood presented a multi-stage process model to guide potential stakeholders through the application of academic entrepreneurship [7]. The model increases stakeholders' success by identifying the activities, actors and key success factors associated with each stage of the process. The benefits of engaging in academic entrepreneurship were also discussed in the article.

Sandhu et al. classified the limitations that affect entrepreneurs into two groups: psychological and institutional barriers [8]. The first group includes barriers such as aversion to risk, fear of failure, as well as aversion to stress and hard work. The second group includes lack of resources, lack of government assistance and lack of social networking. Entrepreneurs at different stages, beginners or established, are affected by different barriers. For example, beginner entrepreneurs, such as postgraduate students, are mainly limited by psychological barriers (budding entrepreneur's barrier), while established entrepreneurs are mainly limited by institutional barriers. The barriers affecting postgraduate students in a developing country such as Malaysia were investigated. It was concluded that the same barriers apply to entrepreneurs in developing countries as for entrepreneurs in developed countries. For example, aversion to risk or fear of failure were identified as barriers for postgraduate students. From an institutional standpoint, lack of resources, social networking (most business relationships tend to rely heavily on social networking) and funding during study

and research were the main obstacles for doctoral students. Proper institutional support (i.e. government assistance) might be especially challenging in developing countries.

Dante Di Gregorio and Scott Shane argue in [9] that intellectual eminence, policies for equity investments in start-ups related to technology licensing, as well as maintaining a low inventor's share of royalties contribute to the growth of new firm formation. Perkmann et al. reviewed 20 years of research on the relevance of collaborative research, contract research and consulting as academic engagement and informal relationships for university–industry knowledge transfer [10]. There were recognized individual, organizational and institutional factors that drive academic engagement and characterize results. The achieved outcomes of academic engagement are different compared to commercialization activities because of a partial lack of understanding about the consequences of academic engagement, the role of liaison offices and the higher volume of engagement activities, compared to patenting and entrepreneurship. Finally, there were also identified future research needs, opportunities for methodological improvement and policy interventions. J. Marion et al. studied around 400 invented technologies during a 10-year period [11]. It was found that faculty productivity in terms of patenting is not related to commercialization success. On the other hand, entrepreneurial qualities are significantly correlated with commercialization success. The experience level of the faculty members and participation in an industry sponsored research agreement are among the significant factors contributing to successfully forming a university spin-out. It was also mentioned that, the academic entrepreneurial and commercial experience have the most positive impact on the formation of new ventures. It was hypothesized that commercialization success is directly connected with personal skills such as productivity and entrepreneurial disposition. The conclusion was, important sources of technological and profitable opportunities are academic inventions and patents, however these are far from commercial use [12-14].

Fernández-Pérez et al. studied how personal and professional social networks affect academics' entrepreneurial interest [15]. Based on a sample group of 630 Spanish academics, it was emphasized that support from mentors, business and personal network promote academics' interest in new ventures. Moreover, certain professional networks may produce interesting implications and insights for both academic and policy maker worlds. Also, Goethner et al. investigated in [16] academic scientists' transition to entrepreneurship by studying their academic entrepreneurial intentions. Survey data from 496 German scientists was analyzed from both economic and psychological perspectives. It was found that attitude and perceived control can predict entrepreneurial intentions, however

social norms cannot. Economic factors, such as human and social capital, affect indirectly entrepreneurial intentions via attitudes and perceived behavioral control. Nevertheless, additional direct effects of both capitals were significantly identified as well. Also, it was found that engaging in academic entrepreneurship influences entrepreneurship intentions only via attitudes and perceived behavioral control.

Åstebro et al. studied how universities may motivate science and engineering students, as well as recent graduates, to create new ventures of high quality [17]. It was concluded that transforming university goals and practices toward encouraging the creation of start-ups led by faculty might not be the most effective way to motivate entrepreneurial economic development. This conclusion is drawn by considering the ration between the faculty-led and non-faculty-led startups of 1:24, which would improve the chances of success for non-faculty-led startup from the numbers perspective only. Franklin et al. analyzed the results of a survey organized by 57 universities in the United Kingdom in order to find out what affects significantly the development of new technology-based start-ups [18]. As per their findings, cultural and informational barriers are mainly considered to adapt entrepreneurial-friendly policies. It is noted that, to develop successful entrepreneurship, a combination of academic and external entrepreneurship may be the best approach. Graevenitz et al. presented a learning model for entrepreneurship education, for the development of which, the data from a mandatory entrepreneurship course was used [19]. The model generates signals to students to evaluate their ability for tackling entrepreneurial tasks. Küttim et al. presented in [20] the content of university level entrepreneurship education and its impact on students' entrepreneurial intentions by focusing on 17 European Universities. It was found that, lectures and seminars are not in significant demand for entrepreneurship education. However, networking and coaching activities are in more demand, while entrepreneurship education has a positive impact. Hong et al. investigated at Zhejiang University, by means of questionnaire, different factors influencing entrepreneurs and found that entrepreneurs' personal backgrounds, psychological and behavioral characteristics may affect them, however the main factor is their interests [21]. It was also mentioned that entrepreneurship education could reduce the risk and increase the reward for entrepreneurs.

The scientific research presented in [22] and [23] explores different factors responsible with growing entrepreneurship, including individual-level skills and experience, technology transfer offices, social networking mechanisms, publication opportunities, training and mentoring, foundations, individual scholarships and globalization. D'Este et al. investigated in [24] different factors connected to the skills developed by academic researchers. It was found that, involving

different sets of skills and expertise of scientists increases technological opportunities and exploitation of entrepreneurial opportunities. Also, among the main features to contribute to the improvement of entrepreneurship are academic scientists' research excellence and discovery of timely technological opportunities, previous collaboration with industry partners and scientific breadth. These factors and models may explain relatively good the motivations for becoming an entrepreneur. However, the technology is changing very fast, especially in the post-Internet bloom, and becoming an entrepreneur is a lot easier. This raises the question of how universities can assist postgraduate students in overcoming psychological and institutional barriers. The primary objective of universities was devoted to teaching and research and this has gradually changed. The role of universities has been changing due to the fundamental change in the system of knowledge production. Nowadays, the relation between university, industry, and government have the triple helix, in which the university can play an important role. The key role of the university is as a collector of talents. Rasmussen et al. divided the change of universities into two waves, the first wave from the 1980s and the second wave from 1990 [23]. Since 1980s the universities begun increasing the collaboration with the industry for university research. This wave was developed until 1990. From then ownwards, the role of universities in obtaining money and support was clearly visible.

Universities also have some challenges in economic development. Increasing the extent of commercialization, visualization of the contribution to economic development and managing the relationship between commercialization and other core activities are mentioned among others [25]. Rasmussen et al. investigated four European universities in Finland (University of Oulu), Ireland (Trinity College Dublin), Norway (Norwegian University of Science and Technology) and Sweden (Chalmers University of Technology). The goal was to find out how these universities perform in this new role (apart from their primary goals of teaching and research) and how different universities and other public and private initiatives relate to each other and constitute a system for promoting commercialization of research at a university [25]. All these universities have increased their commercialization activities in the last two decades to support the mechanisms for entrepreneurship. Coordinating mechanisms with each other and with the traditional university activity is very challenging. Stuart and W.Ding noted in [26] that the faculty members are more likely to become entrepreneurs. This is because they could work with other scientists who had previously ventured into the commercial sector. It was suggested to communicate more with prestigious scientists who have experience in commercializing their work. Other scientific researches, for example [27], [28] and [9], presented that new ventures and entre-

preneurial activity are able to contribute to competition, economic growth and job creation, as well as account for a large portion of gross domestic product. As doctoral students concentrate on a specific narrow field, they may have great potential as entrepreneurs. Leading toward entrepreneurial path requires a precise outline which was mentioned above.

Doctoral students have great potential to become entrepreneurs because of their knowledge and expertise. However, they might face several limitations or challenges throughout their path of being successful entrepreneurs. Among these challenges and limitations, aversion to risk, fear of failure, aversion to stress, lack of resources, lack of government assistance and lack of a social network can be mentioned. Nevertheless, support from mentors (counselors, teachers, tutors or supervisors, for example) and a personal network may promote academics' interest for new business ventures. Although several entrepreneurial factors such as economic values, family background, gender, education, previous employment and past entrepreneurial experience are known as starting points in many entrepreneurial endeavors, the role of universities in many start-ups is unquestionable. Universities can connect academic members to other related enterprises (through networking), can provide proper support to postgraduate students to reduce their fear of failure and other obstacles, as well as help them having sustained entrepreneurial activities. Overall, it can be noted that universities have the most positive impact on the formation of a new venture by postgraduate students.

3 How do universities around the globe foster entrepreneurship?

As we have seen in the literature review, the traditional role of universities of nurturing research and conventional teaching methods has changed a lot in recent years and is continually changing over time. In this section, we are analyzing some of the great universities around the world that allocate considerable amount of their assets on promoting entrepreneurship. Generally, the purpose of university entrepreneurship education is two-fold, contributing to the creation and development of entrepreneurial attitudes and motivation to start a company.

3.1 European Universities

Europe is home to many of the world's oldest and most prestigious universities and many of the exciting and vibrant student cities. In this section, we are going through some of the top universities in Europe with an entrepreneurial perspec-

tive. In this research, we base our findings on how universities are describing the support offered for students regarding entrepreneurship. From the research, we found common trends among the European universities as well as variations between them to foster entrepreneurship. Most of the universities are trying to help students in the initial phase of an entrepreneurial venture by providing courses and collaboration with the industry. Some universities also help students to refine their ideas, business model as well as finding investors.

Special courses for doctoral students

In Europe, support specifically for doctoral students is seldom: most universities do not differentiate between how to foster entrepreneurship for graduate, master or doctoral students. Most of the time there are dedicated entrepreneurship courses for the business students which are part of their degree program. Therefore, transfer of academic research by doctoral students to a business is not an emphasis in most of European universities. As a noted exception, Eindhoven University offers the doctoral course 'Entrepreneurship and Innovation Management' [30]. The course is organized under modules going through the topics of 'Entrepreneurship, Innovation and Design', 'Entrepreneurship & Corporate Renewal', 'Entrepreneurship as Design', 'Product Innovation Management', 'Open Innovation', 'New Products Management' and 'New product idea management'. As its main goal, the course works for building knowledge in entrepreneurship theories, concepts, and frameworks, providing students with the opportunity to review critically previous literature on the topic.

Educational initiatives and programs for entrepreneurship

As the main support expected by universities, in Europe, the presence of educational initiatives with focus in entrepreneurship is recurrent: Chalmers University has the master program 'Entrepreneurship and Business Design' [31], where students can 'learn-by-doing' following one of the following tracks: 'Bioscience venture creation', 'Corporate entrepreneurship, 'Intellectual capital management' and 'Technology Venture Creation'. Similarly, Technion University provides for their students the 'Entrepreneurship and Innovation Summer School', which is a one-month program to develop ideas into a startup [32]. A relevant initiative from the same university is the course 'From Idea to Startup' on the online platform Coursera, offering the possibility for students in any country to follow their educational practices [33]. Eindhoven University also offers the master program 'Data Science and Entrepreneurship' in cooperation with Tilburg University. Other European universities also have special types of graduate programs, for example Southampton University in the UK runs an international Graduate Entrepreneur

Scheme for the international graduates. International graduates who have viable and innovative business ideas can come to UK to develop a business in conjunction with the Southampton University. In this scheme, Southampton University gives expert mentoring support to develop businesses. University of Cambridge runs a range of courses, programmes and facilities for the students who are interested in entrepreneurship. Some examples are, Cambridge University Entrepreneurs, Cambridge University Technology and Enterprise Club, Centre for Entrepreneurial Learning, Graduate Entrepreneur Scheme, IdeaSpace, Cambridge Judge Business School, Accelerate Cambridge and Cambridge Enterprise. In Nottingham University, entrepreneurship support for doctoral students can be seen only in business school's doctoral programs in following areas: innovation and creativity in larger organizations, innovative management of change in the public sector, international entrepreneurship, gender and entrepreneurship, entrepreneurship education, media influences upon entrepreneurial activity, social entrepreneurship, small firm finance. Therefore, it is obvious that European universities provide entrepreneurship education in a large extent for doctoral students who have solely choose the business study path.

Entrepreneurship support

A hands on entrepreneurship support is recognized as the most accessible one. For example, Eindhoven University offers for students one space to build and work on new ideas: Startup Eindhoven [34]. The place works as an incubator, providing space and material for students in early stages of developing their business ideas. Training and coaching is also part of the offer made by the Startup Eindhoven. A community of more than 60 entrepreneurs currently work in the premises, developing their ideas and business. Eindhoven, Technion and Chalmers are also supporting hackaton events [35-37]. Instead of helping specifically doctoral students, Southampton University provide consultancy service for any start-up. Along with this, the university provides general information on their website as part of university's career and employment service [38]. They organize different kind of events, for example Global Entrepreneurship Week to promote entrepreneurship in campus. The four main types of businesses they support are: Self-employed Sole Trader/Partnership, Limited Company, Social Enterprise and Co-operative. For the doctoral students, Cambridge University has a club called EPOC (Entrepreneurial Postdocs of Cambridge). The club's objectives are to create awareness of entrepreneurial opportunities, support members in their pursuit of entrepreneurial careers, foster a multidisciplinary network of entrepreneurial postdocs within the university.

Collaboration between Universities and the industry

In their support for students, collaboration and tight connections with the industry are promoted by universities. This helps student familiarize themselves with current challenges faced by the industry: design, business and technological trends, market share and other important business related aspects. Students can learn about how to place their innovative idea in markets as a product or service. In this type of collaboration, sometimes students are also working in the industry supported projects. For instance, Chalmers School of Entrepreneurship has connections with industrial network in the form of commercialization and exchange of information. Also, Technion master programme brings industry experts to evaluate students' projects. In addition, Technion also promotes off-site activities including business and industry site visits. Following a similar approach, a collaboration between university and society also happens through fostering social entrepreneurship. The master programme at Chalmers University gives the opportunity for students to work in social entrepreneurship projects (i.e. a voluntary/ social entrepreneurship project). From the collaboration between universities and industry, students always benefit. However, in the end, a student needs to choose between working as an employee in the industry or build a startup to make use of the gathered experience. In UK, Nottingham University entrepreneur related education in business school is carried out on the basis of the Haydn Green Institute (HGI) for Innovation and Entrepreneurship that is fully integrated within the Business School and endows support from the family of a local entrepreneur, H.Green [39]. HGI aims for perfection of innovative entrepreneurial skills and an understanding of commercialization of research as new venture creation.

IPR and technological transfer

IPR issues are become critical issues for the doctoral students who are trying to create a business out of their research work. Research work conducted in the university and then transferred into a business, own by a student, could be a challenging task to do in terms of legal issues. Different universities have different strategies to deal with the IPR and technological transfer. Universities are offering courses for students to get familiar with the IPR issues. Technion has a dedicated office for this matter, called T3 to facilitate the connection between new ideas and successful products and companies in world markets [40]. Chalmers has the 'Chalmers Ventures', providing finance patent applications and advice for commercialization of research [41]. Also, in their master programme, Chalmers offer courses on 'Patent and Innovation engineering' to provide knowledge on the topic for their students. Eindhoven University also offers support for students in launching new ideas to the market [42].

Financial support

Some European universities are investing to boost innovation, entrepreneurship and transfer academic theatrical knowledge to a business. Therefore, they require collaboration with the industry. From the financial perspective, Chalmers Ventures invests in companies at four different stages: idea validation, up to 50 000 SEK; pre-seed – projects or companies in exploration phase, up to 300 000 SEK; seed – companies in nail phase, up to 5 M SEK and growth investments – companies in scale phase, up to 15 M SEK. Similarly, some universities organize competitions and offer prizes. For instance, BizTEC is an annual competition at Technion University, where students present their venture ideas and can receive a $10 000 prize [43]. Since 1999 Cambridge University runs a competition called CUE (Cambridge University Entrepreneurs) to support and accelerate entrepreneurship and innovation [44]. In this competition, even new entrepreneurs can get help with training, mentoring and sponsorship.

Overall, European universities are providing support for entrepreneurship for students in general. In other words, there is no specific organization or initiative which focuses on doctoral students. As an exception, we highlight the doctoral course 'Entrepreneurship and Innovation Management' offered by the Eindhoven University. Other initiatives were described herein under various categories: educational initiatives, entrepreneurship support, connection with industry, social entrepreneurship, technological transfer, financial perspective and competition and prizes. However, we understand that more initiatives focusing Doctoral students should be built if Universities aim to prepare their students for a highly competitive market. For instance, those seeking for a career in academia will face a high-competitive scenario. For improving their career options, recent doctors should receive training and support while still in the academic setting, in order to raise their employability chances in the market.

3.2 US Universities

The United States is the world´s leading destination for international students. When it comes to business studies, US boasts many top ranked universities including Harvard and Stanford. We are considering the infrastructure of these universities and try to find out how these can excel in academics and entrepreneurial ventures. In the following, the available entrepreneurship support in US universities is presented as outcome of research done from various online resources. In this summary, US universities that are recognized for their entrepreneurial activity as the best in the world are considered. Among them, Harvard University, Stanford University and Massachusetts Institute of Tech-

nology (MIT) provide the most comprehensive entrepreneurial support. Given the extent to which these universities provide entrepreneurship support, the views presented herein cannot be considered exhaustive and are limited by the information available online.

The main interest of this research lies in the available support aimed specifically at the doctoral students. As the findings reveal, Stanford University is the only university considered in this research that provides customized support for doctoral students. The Accel Innovation Scholars (AIS) program is a platform for Stanford engineering doctoral students aimed at bringing breakthrough ideas to the world [45]. This program supports Stanford Engineering doctoral students in discovering the skills and possibilities of technology commercialization, opportunity evaluation and entrepreneurial leadership. This nine-month program complements the students' research experience with access to leaders and innovative start-ups in Silicon Valley. Through workshops, team projects, case studies and field experiences, scholars build the knowledge, skills and attitude to tackle entrepreneurial challenges and discover opportunities to empower their research experience. To support professional development, scholars are allocated faculty coaches, venture capitalists, corporates and AIS alumni mentors to provide feedback and to offer different perspectives and access points to the Silicon Valley ecosystem. At Stanford, one of every four chosen electives is in the discipline and 95% of the students take at least one course in entrepreneurship. Unlike Harvard, which has a separate department of entrepreneurship, Stanford has no dedicated faculty. Instead, the school teaches the discipline by pulling from traditional disciplines in marketing, finance, and organizational behavior. Stanford also doesn't have a business plan contest because the school views its mission as more educational and not as a launch pad for start-ups. Stanford University has elegantly used its Palo Alto location to serve as a greatly productive incubator for Silicon Valley [46], while Harvard has long been known as the West Point of Capitalism, the breeding ground of the corporate elite. Among its famous entrepreneurs, Stanford counts Nike founder Phil Knight and Electronics Arts founder Trip Hawkins, along with the founders of Sun Microsystems, Trader Joe's, and Match.com, along with a slew of prominent venture capitalists from Vinod Khosia to Brook Byers of Kleiner, Perkins, Caufield & Byers (though Tom Perkins is a Harvard graduate).

Although other universities considered in this research do not offer entrepreneurial support specifically aimed at doctoral students, their offerings in terms of support, programs, funding opportunities and networking are substantial. For example, MIT offers wide range of support services for entrepreneurship [47]. This includes both academic entrepreneurship focused on inventions and advanced

research, and general entrepreneurship focused at creating businesses and taking students' ideas to the market. Various courses related to entrepreneurship are offered by MIT [48], University of Pennsylvania (UPENN) [49], University of California Berkeley [50] or University of Southern California (USC) [51] are examples. The possibility to obtain a degree in entrepreneurship is offered at the MIT Sloan School as the "Entrepreneurship Development Program" [52].

Hands on support

Most of the researched US universities offer hands on entrepreneurship support for their students. Facilities for prototyping are offered, for example Media Lab at MIT [53] or Rocket Propulsion Laboratory [54] at the University of Southern California (USC). Hackathons are another type of hands on experiences organized for students by organizations or students themselves. In such events students are brought together to build new services and products or revolutionize existing ones in a very short time. Hackathons are organized at University of California Berkeley by the Berkeley-Haas Entrepreneurship Program, at University of Southern California (USC) by the SparkSC or at University of Pennsylvania by the AddLab. The MIT Global Entrepreneurship Program, which was found on the principle of "mens et manus" (learning by doing) provides hands on experience in entrepreneurship. At the MIT Global Entrepreneurship Bootcamp, the learning takes place not only in the classroom, but also by starting up a company in a week. Also, MIT Launch prepares students for real world success by building their entrepreneurial skills and mindset through launching real startups. An interesting program offered is the MIT Launch Summer Program that brings together high school students from all over the US and the world each summer to MIT campus to become entrepreneurs in a 4-week program. Students start a company in teams, with the aim to create a real startup to solve a real need in a different way. The focus is on taking action, learning from results, and making changes to improve chances of success. Students are supported throughout the summer to start their companies through interactive classroom discussions and activities, a team of mentors, and many other resources.

For the entrepreneurially inclined students, Harvard is the number one option for a business or technical degree. Harvard is the place where the leaders of the Fortune 500 get trained and it is often called as the West point of Capitalism. Over 20% of the top three jobs in the Fortune 500 are held by Harvard MBAs. The famous people from Harvard include, Jim McNerney at Boeing, Jamie Dimon at JPMorgan, Jeff Immelt at GE, and A.G. Lafley and formerly of Procter & Gamble. Despite these facts, Harvard shines in raising entrepreneurship in recent years. The substantial resources that Harvard offers to the entrepreneurial studies and

projects are the key to their success. Powered by its Arthur Rock Center for Entrepreneurship [55], the school offers 33 graduate-level entrepreneurship courses. But its impulsion spreads well beyond the school. Technology and Entrepreneurship Centre at Harvard (TECH) is a division of Harvard School of Engineering and Applied Sciences (HSEAS), where they provide support and creates a community for undergraduate, graduate and doctoral students [56]. TECH's mission is to advance the understanding and practice of innovation and entrepreneurship through experiential education: by initiating, advancing and informing student projects. TECH aids faculty craft and supply innovation and entrepreneurship project courses, offers students with project support and sponsors and advises student groups working to build the Harvard innovation community.

Social impact

Social responsibility is an important part of entrepreneurship and some universities emphasize this in specialized support and fellowships. For example, at MIT, the D-Lab Scale-Ups [57] was created to identify and support technology ventures with potential for wide scale poverty alleviation. This program is mainly focused on social entrepreneurs from MIT and the developing world. A fellowship program is offered for MIT graduate students who intend to launch enterprises in low-income countries [58]. This fellowship was founded on the belief that economic progress and good governance in low-income countries emerge from entrepreneurship and innovations that empower ordinary citizens. University of Pennsylvania also offers courses on social entrepreneurship, a club for students with social entrepreneurship interests or practical training in social entrepreneurship. Entrepreneurship courses on social impact are offered at University of California Berkley as well.

Technological transfer

Translating discoveries and research ideas into new products and businesses is also considered and offered as a support for students and faculty members in many US universities. For example, the Penn Center for Innovation (PCI) does this by facilitating technology development connections between Penn and the private sector. Whether the end result is a technology license, an R&D alliance, the formation of a new venture or an integrated combination of any or all of these activities, PCI serves as a dedicated one-stop shop for commercial partnering with Penn. UPstart [59], a virtual incubator at the University of Pennsylvania, is dedicated to supporting technology commercialization within the Penn community. The UPstart program offers a wide array of services to assist entrepreneurial faculty members in the company formation and development process. UPstart smooths the path to future success by working closely with faculty members as

they build value into their technology through new venture creation. The MIT Technology Licensing Office [60] manages the patenting, licensing, trademarking and copyrighting of intellectual property developed at MIT, Lincoln Laboratory and the Whitehead Institute. It also serves as an educational resource on intellectual property and licensing matters for the MIT community. Its job is to bring breakthrough discoveries to a wide audience by evaluating inventions for potential commercialization, securing the protection of such inventions and working with the industry to ensure proper development and commercialization of the inventions. It also provides a guide called "An Investor's Guide to Tech Transfer" [61] which aims at providing an overview of how technology transfer works at MIT as well as the necessary steps that one needs to take to commercialize his/her invention and research flown discoveries. If we look at Harvard, TECH is grounded on the belief that boundaries between disciplines, people, organizations, and ideas need to be crossed continually to generate the visions that lead to innovations because socially useful and commercially feasible progressions need the right blend of scientific and engineering knowledge, entrepreneurial know-how, and a mature outlook on entrepreneurial field. TECH enables this universal assessment by aiding as a junction of innovation education. Operating from within the Harvard School of Engineering and Applied Sciences, TECH sponsors and supports many opportunities for the innovation community to gather and exchange knowledge, including courses, study groups, mentorship relationships, and special events.

Collaboration and tight connections with the industry

Industry tie-ups are fostered in many US universities. For example, the Office of Corporate Relations' Industrial Liaison Program (ILP) [62] promotes MIT/Industry collaboration, encouraging the flow of knowledge and resources between the Institute and innovation-driven companies for their mutual benefit. It is focused at helping MIT research make its way to the marketplace and out to the global community. The Rock center at Harvard facilitates unrivaled support to their students and alumni to transform their ideas into successful start-ups. The Rock center was founded in 2003 by iconic venture capitalist Arthur Rock, MBA 1951. Its biannual entrepreneurial summit gathers alumni with proven early-stage traction, and an entrepreneurs-in-residence program invites accomplished founders and funders to hold weekly office hours to advise students. CITRIS Foundry, a University of California – wide program, helps top entrepreneurs build transformative technology companies that make a significant impact on the world. It also connects industry experts with start-ups at University of California.

Financial resources

Funding available for students at US universities are wide and substantial. These help students build their companies or push their businesses forward. For example, Big Ideas@Berkeley [20], supported by University of California Berkeley, is an annual contest aimed at providing funding, support, and encouragement to interdisciplinary teams of students who have "big ideas". Plenty of funding opportunities are offered by University of Pennsylvania as well as the MIT Venturing Mentoring Service (VMS), which among other focuses on broadening MIT's base of potential financial support. The MIT Deshpande Center for Technological Innovation [63] is focused on developing innovative technologies of the most talented researches and taking them to the market as products and companies. The center has been founded in 2002 and has funded more than 100 projects with over $12M in grants. In Stanford, everything one would want to start a company is there, except for funding, and they have venture capitalists as lecturers and relationships with many angel investors who can help for funding issues.

Competitions and prizes

Awards and rewards are also one way for students at US universities to fund their enterprises or boost their business as well as gain publicity. In Harvard, an annual New Venture Competition awards $150,000 in cash plus in-kind prizes. The school also supports graduates who are pursuing new ventures with loan reductions of $10,000 to $20,000. In 2014, 21 student entrepreneurs received more than $325,000 through the program. Pitching competitions are the most common competitions organized in universities around the world. The Lemelson-MIT Program is dedicated in honoring inventions that improve lives. The cornerstone of the program is the $500,000 Lemelson-MIT Prize, the world's largest single cash prize for an invention. Also, the MIT $100K Entrepreneurship Competition offers three independent contest every year. This contest has a tradition of 28 years and was able to bring together students and researches from MIT as well as Greater Boston area to launch leading companies. Besides funding, the MIT $100K brings also to their awardees a network of resources, including mentorship from venture capitalists, serial entrepreneurs, corporate executives, and attorneys, media exposure, prototyping funds, business plan feedback and discounted services. The CITRIS Foundry also offers selected startups $5,000 in cash, plus more than $30,000 worth of in-kind infrastructure and services, as well as gains access to coaching and connections to an extensive network of entrepreneurs and industry experts.

3.3 Inferences on Entrepreneurship Support in Top Universities

It has been observed that the universities who outshine in fostering entrepreneurship have assets dedicated for their students to rely on. The best in entrepreneurial education, like Stanford for example, stand out in this realm because they approach the whole system of education and nurture students in a different way compared to others. While analyzing the stories of the universities mentioned above, most them still miss the category of doctoral students and providing customized services for doctoral candidates to enhance their entrepreneurial talents. In that respect, Stanford can be considered as role model as they have specifically tailored amenities for doctoral students who are interested in entrepreneurship. To conclude, although these high-ranking institutes have outstanding facilities for their students and staff, most of them still need to integrate the varying requirements of students, especially the doctoral candidates.

Overall, the European universities are providing support for entrepreneurship for students in general. In other words, there is no specific organization or initiative which focuses on doctoral students – as an exception, we highlight the doctoral Course 'Entrepreneurship and Innovation Management' offered by the Eindhoven University. Few key entrepreneurship support areas were identified in most of the considered US universities. Among these, hands on support, funding resources, tight connections with the industry, technological transfer frameworks as well as competition prizes can be mentioned. The support covers both academic entrepreneurship, based on advanced research and specialized inventions, and general entrepreneurship. The main interest of this research was to identify support aimed specifically at doctoral students and faculty members and, although few universities offer such support, most of them offer a comprehensive range of support for entrepreneurship that also includes commercialization and business creation from advanced research. Specifically, frameworks for technological transfer or services that can assist faculty members with all matters related to commercialization at all stages are considered to be the most important for fostering academic research. Another important aspect is that such support is offered in a unified and customized manner such that the person willing to access the support needs to visit a single place to obtain all the necessary help. This way, confusion is avoided and the time spent on learning where support can be accessed is reduced to a minimum. This is important for researchers and faculty members that value very much their time. Some universities even provide guides on what to do and where to get help if the support is offered in a distributed manner, with different entities offering different type of support.

Consequently, offering support for entrepreneurship is not enough in itself and effort needs to be focused on making the access to this support very simple and efficient. The underlying assumption is that innovative and viable business ideas are more likely to arise from students pursuing technical, scientific and creative studies. On the contrary, in Europe, most of the entrepreneurship courses are offered in business and economic studies.

We understand that more initiatives focusing on doctoral students should be taken if universities aim to prepare their students for a highly competitive market. For instance, those seeking a career in academia will face a highly competitive scenario. For improving their career options, fresh doctors should receive training and support while still in the academic setting in order to raise their employability chances in the market. Another aspect identified in this research is that the entrepreneurship support can also be virtual. For example, an online platform where doctoral students and faculty members can learn where they could get help, collaborate with other students or communicate with mentors is offered by universities.

4 Aalto University: An Innovation based Nordic Institution

The idea of creating a world-class university by merging three existing universities in the Helsinki metropolitan area was proposed in 2005 by Yrjö Sotamaa, the director of University of Art and Design (TAIK) [64]. The fundamental fields of science and technology were meant to be "diluted" with beauty-bringing design and art, to finally be encased with the artistry of business and economics. The official opening of Aalto University took place in 2010, five years after it was proposed, the new university being called also "innovative". Referring to Cambridge dictionary, innovative refers to using new methods and ideas [65]. It is commonly acknowledged that being innovative does not necessarily mean being effective. According to the statistics, around 40% of doctoral students can count on getting a post-doc position and have the opportunity to continue their career in academia in Finland [66]. Concerning the rest, in addition to industrial and government sector jobs, one solution is to go for entrepreneurial ventures.

4.1 Entrepreneurship Ecosystem in Aalto

How can a freshman in Aalto University with entrepreneurial mindset enhance

and attain his dreams and goals? Aalto University has an innovation component at its core. One year before the three well-regarded universities were merged together, Aaltoes (Aalto Entrepreneurship Society) started to encourage students to become entrepreneurs. This was done by organizing pitching events and workshops where students and researchers could try their ideas, learn essential skills and look for co-founders and people to share their vision. Over the years, an entrepreneurship ecosystem was developed in Aalto University. Various organizations and activities aimed at fostering innovation, entrepreneurship and start-ups, part of this entrepreneurship ecosystems, can be categorized in four groups: education programs, co-working environments, accelerator programs and commercialization and business development. In the following, the four identified groups are analyzed in more detail.

Education Programs

Education programs are presented with three major components such as Aalto Ventures Program (AVP), MSc Program in Entrepreneurship & Innovation and Aalto Executive Education MBA. The Master's Program in Entrepreneurship and Innovation Management is a basic master degree program on Aalto basis that is aimed to develop the knowledge of generating new ideas and implementing them into economically and socially valuable impacts [67]. The curriculum is built in a way that the traditional forms of academic teaching intersect with hands-on experience of working on real business projects and with real customers. Consequently, this study program is only applicable to future master's degree students, those who are particularly interested in entrepreneurship. Aalto Executive Education (Aalto EE) is aimed at experienced managers who wish to improve their knowledge and learn the latest methods in the face of a changing world. In addition to Finland, educational programs are provided all over the world: Baltic countries, China, Indonesia, Iran, Poland, Russia, South Korea, Singapore, Sweden and Taiwan [68]. Along with Aalto EE (aaltoee.com), two similar programs exist: Aalto PRO (aaltopro.fi), which is targeted at experts who consider it vital to keep their methods up to date, and Aalto ENT (aaltoent.fi), which develops educational programs for entrepreneurs to improve their team-leading skills in order to create commercially successful goods and services for global customers. Another education structure, Aalto Ventures Program (AVP), was established in 2012 and was developed as part of the Aalto University partnership with the Stanford Technology Ventures Program (STVP) [69]. AVP provides in total about 20 courses on the basics of entrepreneurship along with design thinking, leadership and innovation courses. In general, AVP offers three groups of courses: Startup track, Prototype track and AVP electives.

Co-working environments

Co-working environments are formed by Startup Sauna, Open Innovation House and Aalto-based factories (Design, Health and Media). Startup Sauna is widely known as co-working space in Otaniemi campus, however, this comprises three main elements focused on the growth of regional startups: Startup Sauna Acceleration Program, Startup Life and SLUSH conference. The Acceleration Program is a free accelerator for the most promising startups that runs semiannually. In the first step, one-day coaching sessions are held across up to 20 locations in the northern Europe and Russia, where startups get feedback on their presentations and best teams are chosen to continue to the second step. The second step consists of a five-week acceleration program during which the startup developers are able to focus on improving their strategies, understanding their customers and fundraising, all under the control of angel investors and VCs. The Startup Life is a 3 to 12 months internship program for undergraduate and postgraduate students, as well as researchers, from Finnish universities, to work at startups in the San Francisco Bay Area and Silicon Valley. The main objective is "to get students out of the university, out of Finland to see what is possible and how startups really work". The SLUSH conference, which can be consider also part of commercialization, has the main objective to "bring together the early-stage startups to meet world-top venture capitalists". The Open Innovation House (OIH) is a newborn co-working space established in 2013, a "base and meeting venue for open innovation and collaborative creation" [70]. It provides a number of spaces for public use and shared activities. OIH hosts plenty of research centers working primarily in the IT sector. Another kind of co-working environments are the three major factories in Aalto University: Design Factory, Health Factory and Media Factory. Aalto Design Factory (ADF) was the first physical entity of the new Aalto University, which was established in 2008. ADF brings together the students and researchers of engineering, design and business disciplines and enables their interaction, experimentation and prototyping within the co-working space. Along with providing with space, ADF hosts approximately 40 different educational courses taught by 35 teachers. Its learning philosophy promotes an idea of training a student to be knowledge-efficient and able to collaborate with people and confront the challenges of the working life. The research community is presented with both in-house permanent and visiting researchers who develop the ADF platform. Aalto Media Factory (AMF) specializes in supporting and developing multidisciplinary media-related research and education. AMF provides spaces, coaching (training), tools and even funding for research projects. Everyone from Aalto is welcome to join AMF. Prototyping can be done at the Fablab workshop, using a laser cutter, 3D printers, electronic equipment and many others. A simple

electronic-based device may be developed in the Electronics studio, where the basics of do-it-yourself are also taught. At Web Studio one can learn more about web design, have a personal consultation, grab learning materials and test own web projects or participate events hosted there. AV equipment can be lent for production or the basics of video editing can be learned through short courses and consultations with professionals. AMF has been supporting various multi-disciplinary research projects until 2015, when the seed funding was put on hold and the support is no longer available. The Health Factory, coordinated by Aalto University School of Electrical Engineering, was established in 2013. The main goal is to promote and support successful solutions for health and well-being related problems that can be used as a new business foundation or as part of an existing company. Some problems have been solved in cooperation with the Helsinki University Central Hospital and other mentors and stakeholders such as University of Helsinki, VTT Technical Research Centre of Finland, Tekes and ACE.

Accelerator programs

Accelerators in Aalto University comprise of Startup Sauna Program, described earlier, and Summer of Startups. The Summer of Startups (SoS) is an accelerator program where an early-stage business idea is developed using various educational instruments such as inspirational lectures, classic lectures focused on teaching the basic tools and principles as well as coaching [71]. The next step is to focus on customer development and business models. Teams get funding, free space to work, professional coachers and "support of the startup community". The program attracts plenty of participants in 15 teams, on average, composed of desired-to-be-entrepreneurs people. Neither Startup Sauna Program, nor Summer of Startups distinguish between students and researchers, as they have no specific way of "treating" the doctoral students. The programs support any kind of idea which seems to have a high social impact potential. Some life-span accelerators were run on the basis of Aalto Center for Entrepreneurship, one example is AppCampus (2012-2015) that was aimed to mobile apps development.

Commercialization and business development

The main goal of the commercialization segment is "to identify the commercially potential innovations and turn them into profitable startups". The area of expertise of Aalto Innovation Service (AIS) [72] is patenting and commercializing inventions done at Aalto University. Aalto University's licensable portfolio falls into five categories:

1. Chemistry and materials
2. Computer science and ICT
3. Energy and Cleantech
4. Engineering and Electronics
5. Medical Device and Life Science

Launching a startup is a challenging task, nevertheless, there are a number of Aalto success stories. Such spinout companies, as SportSetter, MeeDoc, Sharetribe and many others, got known both in Finland and overseas. Aalto Center for Entrepreneurship (ACE) "connects Aalto University entrepreneurship activities with the surrounding ecosystem incubators, accelerators, and investors" [73]. ACE works in strong collaboration with AIS and brings together four key functions, according to the MIT report in [74]: (i) a technology transfer function focusing its resources on high-potential startups; (ii) startup services, to help startups with their first rounds of funding; (iii) strategic industry partnership and (iv) support for and oversight of other E&I activities. One example that was mentioned before is the AppCampus acceleration program on ACE basis. Its goal is to support app development for Windows mobile ecosystem and turn the mobile developers into entrepreneurs. The startups have published about three hundred apps that had been globally distributed through the Windows Phone Store. The Aalto Startup Center (ASC) can be considered part of both accelerators and commercialization segments [75]. It incorporates co-working spaces available for everyone, offers the opportunity to develop a business idea and get support and information about various fields of business and entrepreneurship. The supporting team helps everyone to develop a detailed business plan. Over 700 companies have been placed on-track for growth and more than 2500 new jobs created at the ASC. Startupers have access to the network in order to communicate with entrepreneurs and valuable professionals in the ICT and technology sectors. The Stanford Technology Ventures Partnership (STVP) involves visits of Aalto University students to Stanford University and Silicon Valley, a platform for hosting Aalto startups in Silicon Valley, guidance for new Aalto research in entrepreneurship and support in the design and delivery of the AVP, including the co-teaching of undergraduate courses. Co-teaching of courses and trainings for doctoral students are promising tracks to consider and develop.

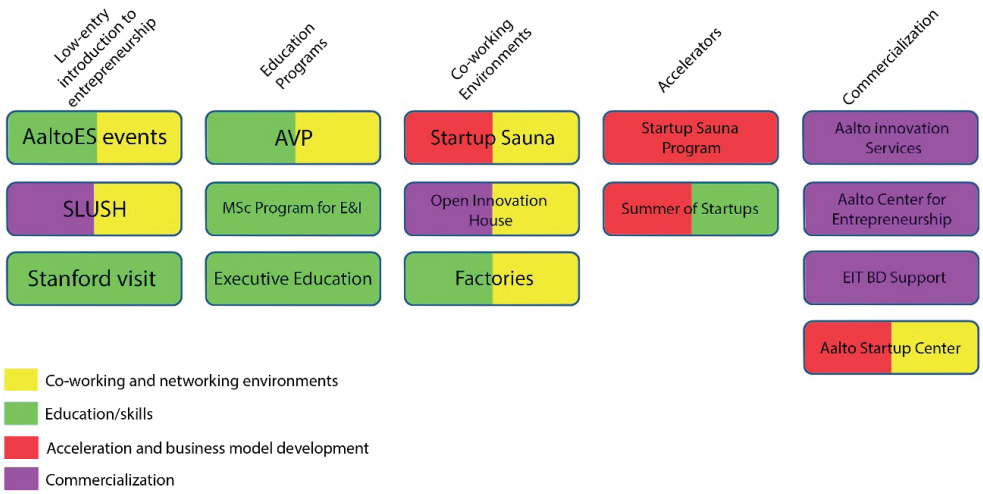

Fig. 1. *Representation of the Aalto-based entrepreneurial bodies in different sectors*

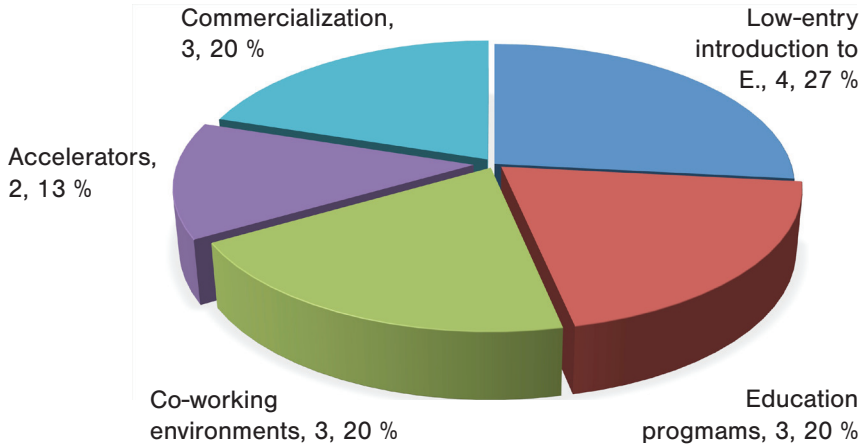

Fig. 2. *Number of Organizations in each sector within Aalto University*

A summary of the Aalto University entrepreneurship ecosystem with a focus on doctoral students is provided in the following. AVP is considered to be relevant and helpful for doctoral students at the moment, although neither the MSc Program in Entrepreneurship & Innovation, nor Executive Education MBA are the options for a doctoral candidate. There is no differentiation between master's degree students and doctoral students in the activities that take place at AVP. Consequently, AVP is only partially helpful to doctoral students by providing courses

on general topics, for example idea and entrepreneurial mindset development, such as "Startup experience" or "Product development project". Another course offered by AVP is "Storytelling – a Narrative Approach for Entrepreneurship".

Another aspect worth considering is enlarging the social network and finding suitable team mates for pursuing an entrepreneurship idea. The events organized by AVP and Startup Sauna are perfect opportunity to meet both possible investors and possible team mates. Aalto-based factories (Design, Health and Media Factories) enable networking and skills development. To certain extent, SLUSH can also be classified as a co-working space where a doctoral student having an early-stage business idea has an opportunity to engage with other early-stage developers in order to collaborate, share their knowledge or develop a product. SLUSH, although not a free event, attracts high level developers, investors and doctoral students with perspective ideas. At the same time Aalto-based factories do not provide specific support for doctoral students and also the offered support is rather unidirectional (especially in media and health areas). Although the Startup Sauna Program and Summer of Startups attract plenty of participants, there is no differentiation between master's degree and doctoral degree students. The programs support any kind of idea which seem to have a high potential social impact. On one hand, it is not crucially important to introduce a differentiation between different types of students, however, on the other hand, special knowledge is expected when considering research-based business ideas. Consequently, mentors with large experience in various fields of expertise are needed and these might be actual supervisors. For commercialization in Aalto University we have the Aalto Innovation Services, Aalto Center for Entrepreneurship and Aalto Startup Center responsible to identify potential innovations and turn them into profitable startups. A number of expert people enable the transition from the idea to a startup in these organizations. Such people help in various matters regarding fundraising, collaboration with incubators and investors, as well as general consulting.

4.2 Doctoral Student Survey

A survey with the objective to investigate how familiar doctoral students in Aalto University are with the available entrepreneurship support was run for a period of four weeks. Doctoral students of Aalto Universities in the six schools were considered for this survey [76]. However only a very limited number of students were reached during the execution period of the survey. The survey was distributed through direct email and mailing lists for doctoral students of School of Electrical Engineering and School of Business. Both schools had a total of 254 students ac-

cording to a 2015 report [76]. A number of 51 students chose to answer the survey with a distribution per school as presented in Figure 3.

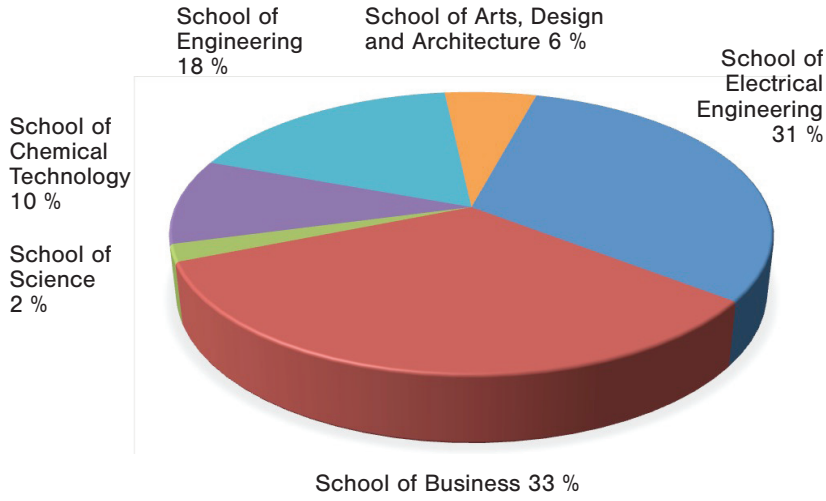

Fig. 3. *Distribution of respondents per school*

A first survey question tried to understand the interest of the survey respondent in entrepreneurship. Out of 51 respondents, 23 consider entrepreneurship as a future career, 21 consider they find entrepreneurship interesting, while 7 are not interested in entrepreneurship. These results show that most of the students that chose to answer the survey have interest in entrepreneurship to some extent. On the other hand, 26 and 16 of the respondents consider that a career in industry is likely and very likely respectively. At the same time, only 10 and 8 respondents consider a career in entrepreneurship likely and very likely. These results are presented in Figure 4.

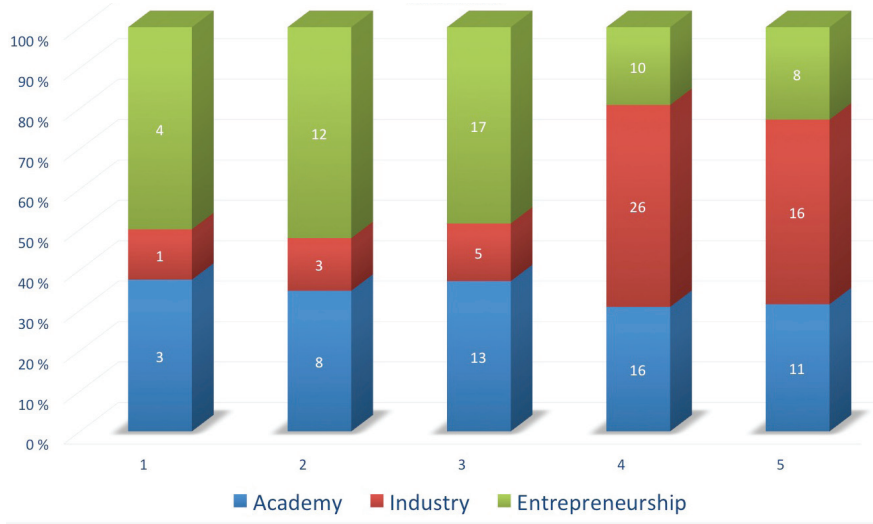

Fig. 4. *Likeliness of future career. The scale 1-5 is from less likely to very likely.*

Regarding the different entrepreneurship categories for a future career, the survey respondents have chosen entrepreneurship stemming from advanced technological products/services mostly versus general entrepreneurship. The results show 33 choices of own doctoral research and 35 choices of other scientific research, versus 20 choices of general entrepreneurship. This shows that the respondents prefer to build an entrepreneurship career on their own research experience or on another related innovative area. It is also observed that some would choose an entrepreneurship career no matter the area.

The survey tries to identify is doctoral students are familiar with the available entrepreneurship support in Aalto University, how well the available support is known by the students and how many have used the available support. Interesting results have been obtained regarding the doctoral students that have accessed entrepreneurship support services both in Aalto University and outside. It is found that only 3 out of 51 respondents have accessed the support provided by Aalto University, while 7 out of 51 have accessed support outside Aalto University. Consequently, the available support in Aalto University is not used by doctoral students and, more important, only 30% of the respondents that have accessed entrepreneurship support have done it from Aalto University, while 70% have done it outside Aalto University from YritysEspoo, Tekes, FINCEAL or Enterprise-Finland for example. These results are presented in Figure 5.

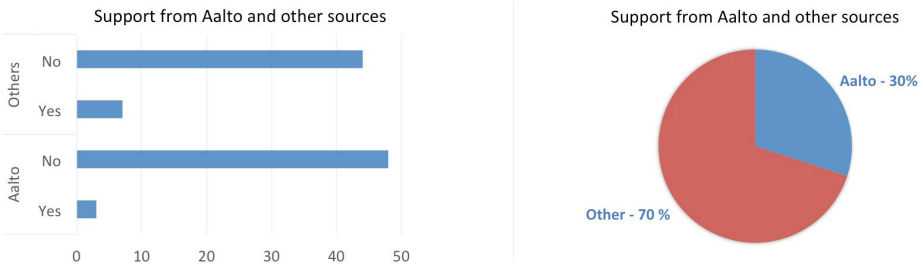

Fig. 5. *Support accessed in Aalto University and outside*

It is interesting to see how popular different support entities, in their various forms, are among doctoral students and how well doctoral students know the offered services by each entity. The results presented in Figure 6 show that the most popular among doctoral students are AVP (31 respondents), Startup Sauna (37 respondents), Open Innovation House (31 respondents), Design Factory (28 respondents), the Startup Sauna Program (29 respondents) and Slush conference (35 respondents). Most of the entrepreneurship related events attended by doctoral students take place in Design Factory, Startup Sauna and Slush. The same entities are also able to clearly communicate to doctoral students the services that are offered. Design Factory is also the winner the entities that doctoral students use their services.

All other entrepreneurship support entities in Aalto University have very little reach among doctoral students. The reason for this situation might be that such entities do not consider doctoral students as possible users of their services and do not try to advertise their services to them, or such entities do not advertise their services sufficiently in general.

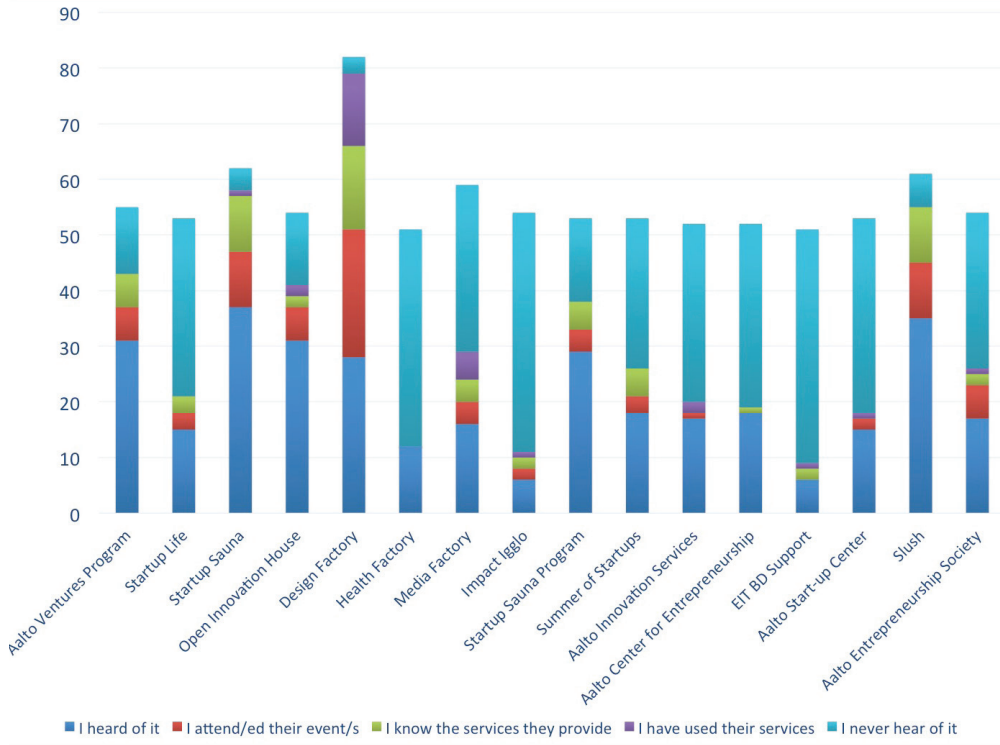

Fig. 6. *The reach of different entrepreneurship support entities inside Aalto University among doctoral students. The plot shows the number of different responses for each entity*

An open answer question was addressed to the survey respondents regarding what kind of help they consider Aalto University should provide to doctoral students. Few main ideas extracted from these responses are presented in the following in decreasing order of their prevalence among responses. One of the most common concern is that entrepreneurship is not promoted enough among doctoral students of Aalto University. It was also noted that there is a need for a solid framework for academic entrepreneurship, where students can get help, networking and understand what steps they need to take in order to commercialize their research. Also, the offered support should be provided in a one stop shop manner, where students could get all the needed information or help. The current situation in Aalto University with many different support entities is confusing. A significant portion of the respondents also consider that the information offered by support services is not clear of insufficient. Few respondents admitted that they don't know what services are provided or what to do if they would like to commercialize their research. At the same time, few also consider that all the support needed is already available and one just needs to want to pursue such endeavor.

Another opinion that came up several times is that the professors should encourage entrepreneurship and at the moment this is not facilitated by the university in any way. Professors do value more the time spent on research than the time spent on commercializing their research results and, consequently, they do not encourage such activities in their groups or departments. It was also noted that stronger collaboration with the industry is needed. This would also benefit students by providing them experiences that they would not get otherwise during their studies, experiences that are important to have when starting a company. It was also noted that instruments that focus specifically on doctoral students are needed to encourage commercialization of research. A policy change regarding patents generated from research was noted as necessary, specifically in terms of the costs Aalto University is requiring for these.

4.3 Survey Findings

A main conclusion from this survey is that doctoral students are not aware of all support services or entities offered by Aalto University in general. This is caused because not enough promotion of such services is done among doctoral students. Most of the efforts of these support services are focused on general entrepreneurship rather than academic entrepreneurship and research commercialization. The large number of such support services and the lack of coordination among these cause confusion among doctoral students.

Although Aalto University provides entrepreneurship support at this moment, few doctoral students take advantage of it. More students seem to seek help outside Aalto. This is either because students don't know the support they could get in Aalto or it is difficult to get it. Either way this issue has to be addressed in the future. The free form answers in the survey provide interesting findings. Students confirm that entrepreneurship is not sufficiently promoted among doctoral students, either by the entities providing entrepreneurship support, by their supervisors or generally in Aalto. The lack of a solid framework for academic entrepreneurship was identified and also lack of focus on both encouraging doctoral students to commercialize their research and the way the entrepreneurship support is offered in Aalto University.

5 Conclusions and Recommendations

Academic entrepreneurship is unequivocally a viable option for those who are in academia. Having said that, the current system in the universities needs to be

changed in order to accommodate the essentials of doctoral students. Universities need to perceive the distinct nature of doctoral candidates and the necessity for their custom-made attention. One example is Aalto University, where sufficient funds, manpower and organizations inside the university are available and meant to support the students to meet their entrepreneurial goals. However, lack of coordination among different bodies and the absence of special care for doctoral students stagnates the raise of the university as a top ranker among entrepreneurship based institutes. Not only Aalto, but majority of the universities in US, Europe and Asian continent have the same issue which needs to be addressed. More importantly, one thing that must be clearly understood by universities is that entrepreneurship education is not learning about entrepreneurship, it is getting the skills to try out and experience entrepreneurship.

Entrepreneurship education should be organized in a dynamic way taking into account research and real business needs. A performance assessment system and feedback sessions with people from university, business sectors and alumni can be a powerful strategy. The Organization for Economic Corporation and Development (OECD) suggests that a joint resource center providing an online information system of pedagogical practices, freely accessible for teachers, researchers, students and other organizations involved in entrepreneurship education, could greatly contribute to the development of a more efficient entrepreneurial learning environment.

Based on the survey findings, Aalto University needs to refocus and restructure the entrepreneurship support it is offering in order to provide a clear picture for doctoral students of what help they can get and where to get it. As student feedbacks suggested, everything related to entrepreneurship should be under one organization/entity and a simple guide on how commercialization of research is done in Aalto University needs to be provided.

Aalto University needs to address the scenario that more students get help from organizations outside Aalto University rather than inside and the cause for this should be found. Possible causes for this situation might be the lack of sufficient information about these services or how difficult accessing these services is. Encouraging research commercialization should be a priority, aimed both directly at doctoral students and indirectly at their supervisors and departments. Doctoral students should be the main target group for entrepreneurship in Aalto University in order to foster research commercialization. A solid framework is required as well as more incentive for professors to promote entrepreneurship is needed. The information should be clearer and support services need to be restructured to include doctoral students as well and provide all the help in a one stop shop manner. A survey on the spin-off companies from Aalto is a good option

that we propose as a future work, in order to get an insight on the university's role in constructing these start-ups.

Aalto Innovation Services (AIS) can be considered as an appropriate academic entrepreneurship framework. Its aim is to manage the university's patent portfolio and to commercialize research done at Aalto. Nevertheless, the services are not advertised or intended to be advertised to doctoral students. This does not require much effort or resources and the potential benefit of enlarging the reach of the service in Aalto is considerable. One option that can easily be implemented is to advertise the AIS to new doctoral students in the introductory courses and events organized at the beginning of their degree in Aalto School of Electrical Engineering for example. Introductory courses for doctoral students in Aalto already advertise other services like library and language, as well as promote alumni who have chosen an entrepreneurial career after graduation. Another important aspect observed also from the doctoral students' survey responses is the publicity that success stories of entrepreneurship in Aalto is not enough. On the AIS website, they have presented few success stories, however these should be publicized more through various channels. This way, more doctoral students are encouraged and inspired to start their own ventures.

Entrepreneurship culture in Aalto was founded by AaltoES, a student organization with the scope of promoting entrepreneurship in students at all levels. This culture has developed considerably in Aalto over the last few years in a down-top approach. By down-top approach, it is meant that the students are driven towards entrepreneurship and organize themselves in a strong network, without the involvements of the top management of the university. Support, in terms of financial support, logistics and real estate is offered by the university at the request of students. The same type of approach is not applicable to doctoral students interested in entrepreneurship. For them, a top-down approach is needed and the top management of the university needs to rethink how doctoral students use their work time and provide them with clear and simple support for entrepreneurship. The reason for this, which to some might seem like babysitting, is because the traditional doctoral degrees require a change in order to be competitive in the current world situation. As doctoral degrees are very strict and strongly regulated in terms of quality, quantity and time of the requirements, the change needs to be addressed at the top management of the university first. A framework that would allow entrepreneurial activity as part of the doctoral degree needs to be in place and this can only be done in a top-down approach. Only after that, we can expect an entrepreneurial culture to flourish among doctoral students.

Another aspect of entrepreneurial culture that needs to be addressed by Aalto

is the concept of "giving back". Specifically, alumni of Aalto University who have achieved success in their ventures should collaborate with the university or its organizations to help and mentor students interested in entrepreneurship. Such collaboration can be done in various ways, from donations and scholarships to coaching and mentoring. A similar culture can be noticed in California, where successful and wealthy alumni make donations, employ or collaborate in new ventures with fresh graduates of their alma mater. This keeps them involved in the evolution of the university and allows them to give back to the people and organizations that once helped them develop to become successful.

From the study on entrepreneurship ecosystem in different universities around the globe, we have formulated few ideas that could improve the entrepreneurship fostering ambience in universities. These are presented in the following.

Supervision of doctoral students needs a reform

Supervisors can open the eyes of doctoral students to the idea of entrepreneurship and they should encourage students. We consider that this would require the education of supervisors and entrepreneurial guidance should be enforced by the university to be part of the supervision process. The supervisor-doctoral student relationship has a key role in promoting and fostering academic entrepreneurship. Reforming supervision does not mean that supervisors will train students in entrepreneurship. On the other hand, flexibility in working and studies can make a difference. If the supervisor is ready to agree on working partly on or researching on projects outside the main doctoral thesis and provide facilities to do so, the whole environment becomes more multi-faceted and diverse, which in turn creates an innovative ambience for entrepreneurs.

Specific support, aimed at doctoral students, needs to be organized

At the moment entrepreneurship support in universities is at the general level, which encourages "fart-app" type of entrepreneurship. The return of such entrepreneurial endeavors is rather low and short-lived, while academic entrepreneurship should hold huge return and significant gains. This comes mainly from the skills and depth of understanding that the doctoral students learn and can provide further. For this highly specialized research to be brought to market, doctoral students need complementary skills (an electrical engineer might need business, marketing, legal or financial skills, for example) or they need to build an efficient team of people that possess the skills that they lack. Therefore, a hub or a networking place/platform for doctoral students needs to be put into place, for example, where a doctoral student interested in taking his research to market can find his future team members or get advice and guidance on how and

where to get funding. Usually, highly specialized products require lots of funding in the beginning, in contrast to nowadays so common smartphone applications that only require coding knowledge and a computer. Internship programs help in networking and meeting specialists with international background.

Clear differentiation between research-based entrepreneurship and "fart-apps"

Research from doctoral students is top notch and is passed through rigorous peer-review processes. It also has international visibility, which can potentially lead to an easier globalization of the product and/or business. When it comes to attracting investors, research based ventures sometimes fail to get funded due to the lack of potentially successful business elements or weak commercialization strategies. A platform to mould the scientific ideas to a business proposal by incorporating the commercial aspects will be a worthy approach from universities' side to support the doctoral students.

Vision on academic entrepreneurship in terms of success needs a revision

University leaders need to understand that investing in entrepreneurship support for doctoral students provides greater return than supporting "fart-apps" type of entrepreneurship. Successful academic entrepreneurship has the potential to generate great revenue, which is returned through donations, taxation or other channels to the university.

Entrepreneurship is closely connected with development and equal opportunities. It is also about finding sustainable solutions to overcome the injustices of poverty (S. Vyakaranam, World economic Forum, 2009). When it comes from academics, entrepreneurships will have an added potential for societal and economic development. With improved vision from the sides of universities and students, academic entrepreneurship can be raised from a third-way perspective of being a choice after academia and industry to a first choice for those who have entrepreneurial mindset.

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From Earth to Cloud: Relevance of Location in Digital Platform Economy

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ABSTRACT: *Digitalization is a megatrend which is radically changing the economical, entrepreneurial, cultural and organizational structures of the modern post-industrial age. It is spearheaded by the platform-based digital ecosystems that have presently established themselves as a dominant model for business development and services. Moreover, they have integrated seamlessly into our lives and have steadily become a game changer in the entrepreneurial world. This article aims to assess the relevance of location for a modern digital platform entrepreneur and, how this criterion shifts in the future. While location studies conducted so far include mainly traditional companies of the industrial era, an analysis for the current crop of digital platform economies is missing. The paper analyses the traditional location evaluation for industries and illustrates the non-applicability of these approaches in recent times. Additionally, the business models of three different domain-specific digital platform companies are studied as an example to illustrate the mentioned paradigm shift and to evaluate the impact of location factors on their prospects of expansion and successful operation. Conclusions from these case studies enable short-term predictions about future trends of expansion for digital platform businesses. The main takeaway is that the location of the startup loses relevance with increasing globalization and progressive changes in local legislations along with other factors. More and more companies and angel investors eagerly support startups that are scalable and enable further growth and world expansion to bring their services or product worldwide.*

KEYWORDS: *Digital Platforms, sLocation dependence, Entrepreneurship, Digitalization.*

1 Introduction

A platform is a framework that enables business interaction between various groups of collaborators and creates value from these interactions. The two most common groups are producers and customers. Business platforms date as far back as to first bazaars in Persia [1]. A bazaar is a marketplace that enabled collaboration of merchants, artisans, bankers and customers, creating value from their transactions. Thus, location of businesses and platforms was extremely important for their success. Usually, cities better located, situated near trade routes and near the sea were much wealthier than the others were. A port city, for example, often attracted many trade ships and various merchants, and had a marketplace that helped create revenue and prosperity for the city. The vivid example of relevance of location in historic times can be illustrated with the city of Bruges in Belgium. During its golden age in 12th century, the city of Bruges was terrifically located at the crossroads of the northern and southern trade routes. The city became an important part of entrepreneurial development in the country thanks to its tidal inlet. It was called "the Golden Inlet" or the Zwin channel that brought the city its prosperity and Bruges became well known all over the world for its merchants and artisans. However, gradual silting of "the Golden Inlet" in the 15th century ended its blooming. The city soon dropped behind Antwerp and, even though, several centuries later a new access to the sea was built, Antwerp had already established its dominance and Bruges gradually faded.

This example shows how important that connection to the sea was for the development of a city, emphasizing the relevance of location. Presently, we have long progressed from barter and simple trade models and now we live in the time of digital revolution. Platforms have become digital and, in comparison to traditional business models, the value creation is not anymore linear. Thanks to advancements in technology and computing, developments in Cloud and Internet of Things (IoT) has made it possible to connect, literally, any device in the common network. Advancements in mobile technology now allow digital platform companies to place their services and products right in the pocket of every customer. This brings us to the question: has relevance of location changed over time for businesses?

There are several studies, where researchers built theories and models drawing a line between location and success of the company. Classical theories have identified groups of most important location factors, crucial for company's success with empirical studies. However lately, the mentioned advancements in technologies and digitalization have induced changes in company's structures and business models. The common theories are, perhaps, not applicable anymore

to digital platform companies. Our paper investigates this and presents implications of classical theories on several case studies to research possible shifts in location theory and introduce new relevant factors.

Section 2 defines digital platform companies, classifies them, and explains technological achievements that are behind the digital revolution. Section 3 presents the traditional location theory, as well as new factors. Section 4 analyses the importance of location for three study cases. The three cases are all Finnish digital platform companies, which represent various niches of business. Section 5 discusses the necessary shift in the general location theory, induced by the growth of digital platform economy. Additionally, it discusses several factors that are rapidly gaining weight and possible future trends. This is followed by Section 6, which summarizes the key findings from this study.

2 Digital Platform Economies

Digital platform economies operate by digitalizing consumables as well as services. It creates revenue by monetizing people's activities such as internet browsing (Google), or their social and professional networks (Facebook and LinkedIn) to name a few. [2] These platforms are at the center of the digital revolution powered by the immense advancement in computing power. This computing power is shareable, purchasable, and tradable. Digital technology has also created explosive innovation for marketers, resulting in everything from new ad formats and content channels, to immersive consumer experiences. The software layer has so intangibly interwoven itself into the economic layer that the norms and scales used to define traditional industries fail to capture the essence of digital platform companies.

While it is very arduous to find a definition of a digital platform, several sources have described this broad concept in, what we believe, a very accurate way. Platforms can be defined as frameworks that permit collaborators – users, peers, providers to undertake a range of activities, often forming entire ecosystems for value creation and capture [3]. Oftentimes, platforms are complementors, powerful for building and maintaining success for the master platform, for example Apple and Android. Some platforms like Google or Facebook are digital platforms providing search and social media, but also platforms on which other platforms are in turn built [4,5].

The era of digital platforms was ushered in by the huge advancements in information technology. It thrives on data and algorithms and the immense cloud computational power form the foundation of their existence. Algorithm is a set of

rules a machine (and especially a computer) follows to achieve a particular goal [6]. In digital platforms, algorithms process raw data to provide economical value. Presently, thanks to binary code, various activities, that earlier were unmeasurable, can be quantified and converted into code. In this way, these processes can be reduced to computable algorithms, interconnected in a common software layer, the IoT. Algorithms dramatically ease the creation of platforms [5,7]. The software layer provides the availability and lowers the cost of access to various tools. The main means of costs drop are through open-source software, the tools provided by other platforms and cloud computing [5].

Cloud computing is a type of internet-based computing that provides on-demand access to shared computer processing resources and data storage to computers and other devices. It is a configurable pool of computation power. If necessary, purchased computation power can be rapidly increased or decreased with minimal effort. Clouds, such as Amazon Web Services, Google Cloud, and Microsoft Azure provide users and enterprises with capabilities to store and process their data in third-party data centers that may be located far from the user; from nearby city to anywhere across the world. Cloud services can be purchased as a variety of packages, from just a hosting service to scalable computing blocks; creating virtual machines and installing own operational systems (OS). It allows companies to avoid up-front infrastructure costs, such as purchasing servers and the necessary maintenance. Thus, cloud computing enables sharing the necessary resources all over the world with convenient scaling. The consequence is a radical reduction in the cost of computing resources and overcoming the boundaries of physical location.

2.1 Classification

There exists a great variety of digital platforms. To illustrate the complexity and entanglement of various platforms and their complementors, we can take the example of YouTube, which is a platform for uploading videos in the cloud. Complementors for YouTube would include applications such as AppAnnie that ranks the revenue generated by other applications: various advertising platforms, and an abundance of other user utilities. An example of an advertising platform is TubeMogul, which enables brand marketers to measure reach, frequency and impact of advertising [8]. These complementors are powerful tools for building revenue for others from the master platform by generating the data transactions or organizing other work [5].

The simple approach to categorizing digital platforms comes from its definition. It is possible to draw a general classification of digital platforms depending on their hierarchy without getting lost in the specifics, as a great number of plat-

forms are interconnected between each other in all possible ways. The general categorization is presented in Table 1 below.

Table 1. *General classification of digital platforms.*

Category	Description	Example
Master Platforms	Platforms for platforms	Amazon Web Services, Apple, Google, Microsoft Azure, Android
Complementors	Other software platforms built on top of master platforms	YouTube, Instagram, Google Maps, Netflix, iTunes, Spotify

Note: There *exist platforms, which are complementors for other complementor platforms. These are put into the complementors category as per this classification, since they are essentially complementing a master platform.*

These diverse platforms have created business ecosystems, repackaged work relationships, and/or transformed terms of competition [5]. Let us take a closer look at disruption that platforms brought to traditional industries, where a great number of companies face a change.

2.2 Disruption

To attune themselves with the current trends, most industries are now facing the need to separate themselves from the traditional structure they were built upon. Secure markets and monopolies, which seemingly were immune to becoming digitalized, have been disrupted by innovative digital solutions. Traditional businesses that are now being famously challenged by digital platforms include Uber which threatens the taxi business in multiple cities around the world; Airbnb, that has transformed the hotel industry; iTunes and Spotify that challenge musical business; and Netflix which has made a mark on movie industry. These digital platform companies have disrupted set industries and revolutionized them, while many others are emerging rapidly.

Fig.1 illustrates the various economic activities redefined and reconfigured by emerging digital platforms [5]. The most remarkable shift has come in the way 'value' is created and monetized. It directly affects the industry and its labor demands. However, it creates additional challenges, such as maintaining and protecting a competitive advantage. Since the barriers for new entrants are low, oftentimes smaller players may have more success locally than the other big platforms. Thus, each of these disruptive processes can be location-sensitive and be motivated by geo-economic reasons.

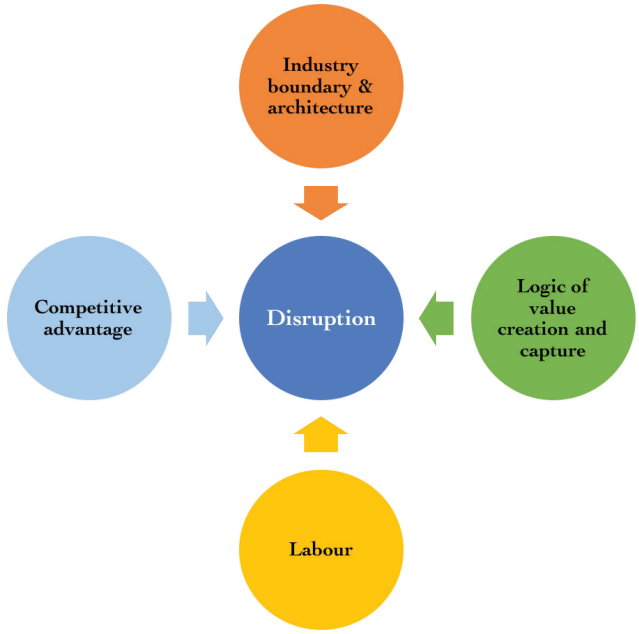

Fig. 1. *The key economic activities which are redefined and utilized by platform economies to create disruptive new businesses.*

The difference between the traditional value chain business model and the platforms' two-way continuous value creation is illustrated in Fig. 2. The new platform-driven business model is not linear and requires more parties to interact, not all of which are co-located. Thus, with emerging digital platforms, boundaries are being erased. For instance, it is no longer necessary for a company to follow the traditional way of expansion and to assess traditional location factors in the same way to get access to a new market [9].

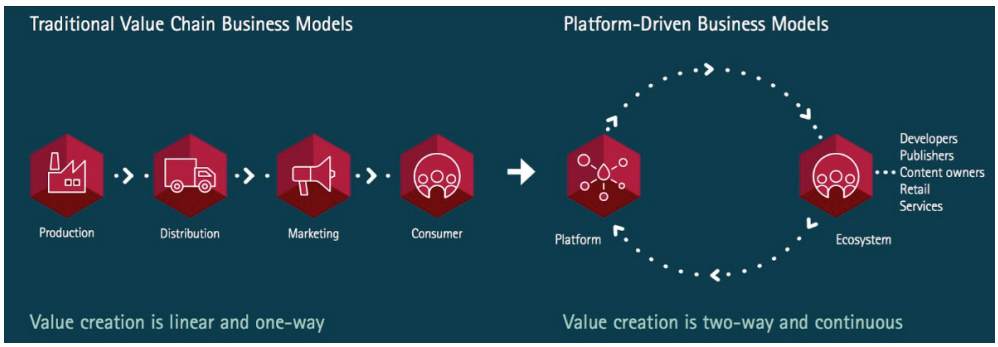

Fig. 2. *Differences between the traditional Value Chain Business model and the Platform [10].*

While everything is becoming digitalized, the data is turning into the new raw material for the emerging digital platforms. With the development of sensor driven ecosystems (forming the IoT) and affordable cloud computing, the amounts of obtained data has increased dramatically. Additionally, reliable internet connection, available now more than ever, has become a simple and fast solution to transfer the data across the globe. It is not necessary anymore to be physically present in the location, to provide the service. For master platforms, it is enough simply to be out there in the web and have your customer connected to their Cloud Servers.

Presently, many companies do not have to handle their customers in person. Unless you need to hand over the product yourself, you can sell it through an internet store, agree with the local postal service and deliver it to the customer without ever being present in his country of origin. Even teaching has become distant, many educational startups provide online lessons and courses, and even educational institutions have their degrees available through internet.

It is already apparent that economic and social life are changing correspondingly, transforming at a swift pace. Many people in developed countries now often find themselves collecting neither music nor movies. They are available in the cloud, as reliable internet connection in developed countries allows availability of such services almost anywhere and in your own pocket with an affordable cost. Hence, the platform economies are likely to effectively define the digital era, with algorithms, internet and cloud as its building blocks [5]. Fast internet and better tools for chatting, collaboration and task management has made it possible to work in distributed teams throughout the globe. Future advances in virtual and augmented reality technologies will change the way we interact and work with each other. For example, you could be in an office anywhere in the world without having to travel to that location.

2.3 Summary on Digital Platforms Technology

The diversity of platforms, based on various algorithms and databases, are restructuring major parts of the global economy. In many cases, they have disrupted the existing organization of economic activity by lowering entry barriers and changing the logic of value creation [5]. In the end, digital platforms are much less about geography and are more about how algorithms and computing is done. As a result, from technical point of view, location is becoming irrelevant, which suggests development of different new models and strategies for companies' scalability and growth.

3 Business Location Factors

Traditionally, the choice of a location to start a new business or to expand an existing business into a new location has been seen as a decision critical to a company's success. The underlying reasons for business location decisions have interested researchers in strategic planning, organizational behavior, economic geography and regional economics for over fifty years [11]. Although digital economies by their very nature are seemingly completely above dependencies to location, external factors may link them together once again. The endeavor is to marry these opposing ideas and understand the possible ways various location factors affect digital platforms. Initially, to understand the disrupting effect that digital platform economy has brought with it, it is crucial to look at how existing research has explained location decisions in the past. We will see that the way digital platform economies operate will challenge most, if not all, of these traditional ideas.

Literature Review: An extensive literature review [12] states that the previous research on business location factors can be classified into the following three categories: 1) studies focusing on measuring the influence of a specific location factor or a set of factors on a business location decision; 2) studies focusing on explaining the location decision process for a specific business category and 3) studies focusing on identification of the location factors leading businesses in specific areas [12].

The rich historical tradition of location theory started already in the early 1800s from the study conducted by Johann Heinrich Von Thünen (1826) [13]. In the study, he claimed distance as the most important factor in defining the price of rent (in agriculture). Another early theorist was Wilhelm Launhardt (1885) who provided a significant contribution by using cost and demand factors at alternative locations to explain the differences in the location of industry [14]. Additionally, he pointed out the importance of transportation costs [15]. In the early twentieth century, Alfred Weber (1929) developed a least cost theory by studying the factors that influence industrial location [16]. He considered three factors: transportation costs, labor costs and so called agglomeration forces [15]. Around the same time, Harold Hotelling (1929) introduced a spatial approach to economic competition [17].

After the early location theories, a growing number of researchers started to investigate the factors leading to company location decisions through empirical studies. Between 1950s and 1970s, the research still focused mostly on choosing the location for industrial activities. Most important business location factors were considered to be the proximity to raw materials, proximity to markets, and supply of labor [12].

Notable research towards spatial analyses was done by Walter Isard (1956) [18], the principal founder of regional science. He tried to develop a general theory of location by combining the previous work done by earlier theorists like Von Thünen, Weber and Lösch [14]. Between the period of 1970s and 1990s, industries were no longer the dominant topic and, as the technology developed, other forms of entrepreneurship started to emerge. Traditional factors, proximity to raw materials, market access and supply of labor gave room for additional factors such as environmental regulations, trade unionism and quality of life [12].

Paul Krugman, a Nobel laureate in economic sciences, states that the analysis of international trade makes little to no use of insights from economic geography and location theory [19]. A year earlier, he had already suggested to incorporate the long and informal tradition of location theory into more formal models; a thought that later spawned a field called new economic geography [20]. After the 1990's, business location factor has become an issue of increasing interest within research [12].

The traditional emphasis on factors of proximity to raw materials, markets and labor has now given way to include several other factors in various studies. However, the reasons why a certain set of factors was chosen are rarely explained in the literature and it is often difficult to draw the line between factors. However, these studies are limited only to traditional industries and do not discuss the digital platform economies. Even location studies exclude these from their scope. However, for the sake of this study on digital economies and for comparison purposes later, we will base our location arguments on factors identified for traditional industries, and continue to explore new factors at the right time.

The comprehensive literature review in [12] scans through a otal of 69 peer-reviewed articles related to business location factors published between 1950 and 2013. As a result, the authors divide whole variety of business location factors into the following ten groups: Market, Cost Factors, Labor, Raw materials, Transportation & Access, Financial Incentives & Taxes, Government Regulations, Infrastructure, Quality of life & personal motives, Business Climate. In the following section, we look at the factors closely, explaining what they cover and their use. Here, we present the most frequently studied factors in recent studies (transportation & access, government regulations, financial incentives & taxes and quality of life & personal motives), and discuss their relevance in the context of digital platform economies. A summary of the more crucial location factors in traditional location theory are presented in Fig. 3 below.

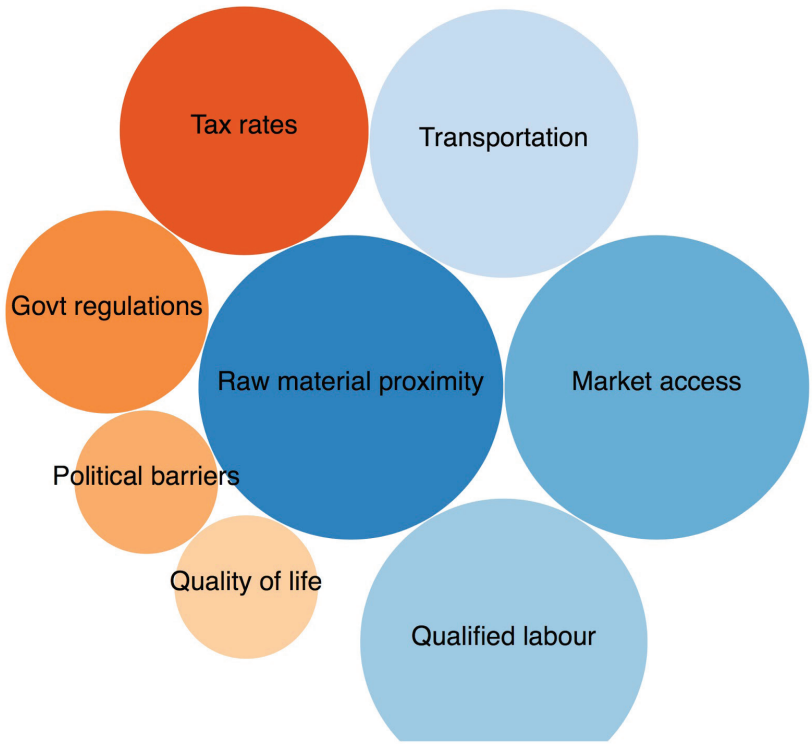

Fig. 3. *The main factors on which decisions on the location of a traditional industry were made. The importance of the factor is proportional to the size of the bubble.*

3.1 Transportation and Access

The role of transportation has a long tradition in classical location theory. Several empirical location studies have surveyed the impact of transportation on business location decisions through series of questions regarding the company's characteristics as well as location factors related to transportation [21-23]. Roads are frequently named as the most important type of transport infrastructure in these types of studies. The results from [24] also agree and point out that for industrial location the interregional road transportation infrastructure is of more importance than other means of transport such as ports or airports.

Thus, a poor road infrastructure at a location highly discourages a company from migrating there, mainly due to the missed opportunities in saving delivery times and better customer services, that come with a reliable road network [22,25]. This is reflected directly in the findings in [23], which suggest a positive correlation between access to primary highway facilities and the level of eco-

nomic activity. Therefore, the quality and range of road transportation system at a location has a big impact on company's successful expansion there.

The concept of transportation and accessibility has different implications when it comes to digital platform economies. For many digital platform companies, unlike industrial production houses, it is not crucial to rely on well-functioning road or railway networks where they work, and there is no need to locate near harbors. The services themselves are always physically near their customers via their smart devices - at their best, customers carry the services in their pockets 24/7. Of course, developed transportation networks make an impact on digital marketplaces where goods have to be shipped elsewhere. The concern here is the producer and warehouse location and their connectivity to transport networks. Road transportation aspect is important when platforms deal with restaurants, where quick delivery of items is a requirement. To sum up, in most cases the importance of a solid transportation network is minimum as there are no physical goods to move, except with: a) platforms used by actual service businesses (restaurants, etc.) or b) when it is important to have experts that tend to be mobile.

However, what is crucial for digital platform companies in the context of customer access is a well-working internet connection. For a web-based company it is, by definition, vital to operate in a location where there is a working and affordable internet access to its potential customers. It should not be disregarded that still at the end of 2015, 57 percent of the world's population, or four billion people, remained offline [26]. In addition, the quality and affordability of internet connection also vary dramatically from one location to another. Even if people have higher incomes, expensive devices and data-transfer costs can make it impossible to access digital services. Users must be able to cover the device cost, broadband and connection fees comfortably. Smartphones tend to be expensive, and data plans put internet access out of the range of many individuals. Digital platform companies are more likely to succeed in locations with affordable web services, reasonable costs for being online, reliable infrastructure, and uncensored online information. We thus suggest that in the context of digital platform economies, the factor of transportation and access should be understood mostly as "access to internet".

3.2 Government Regulations

The political environment is one of the least predictable factors in a location's business environment. Even if the political situation in a location is quite stable, the political environment tends to be in constant movement. As democratic governments are re-elected every few years, the political environment develops

cyclically, and is constantly under the influence of various lobbyists. Pressure groups tend to affect government policies, and for an entrepreneur it is very difficult to forecast future tendencies. In addition, as political systems vary from one location to another, the political impact of different actors differ as well. In democracies, the state's population elects the government, but in totalitarian systems, the government's power derives from a usually small, selected group. An entrepreneur should also understand the realism of the political environment he or she wishes to enter: for example, bureaucracy and corruption are barriers for businesses in many countries. Additionally, the lack of political stability in a location can affect business operations dramatically. In a worst-case scenario, an aggressive takeover could overthrow a government and lead to general disorder in the environment that disrupts business operations. The Arab Spring is an example of such situation.

There are also multiple other dimensions in political environment that potentially affect business: taxation (that will be covered in the following subchapter), education law, employment law, discrimination law, data protection law, health and safety law, regulation and deregulation, and intellectual property law, to name a few. Quite surprisingly, environmental law and regulations have been found unlikely to have a large effect on the location decisions of the average industry, except specifically in the field of motor vehicle industry [27,28].

Digital platforms raise many new policy questions. Some scholars have even stated that legal disruption is not merely an accident of the platform economy; it is its core feature [29]. Digital platform companies are likely to show how the law is out-of-date. They often appear alien to the law and indeed challenge the territorial aspect of (national or multinational) laws. Governments are not only concerned about the risks, but also interested in the opportunities and benefits that the platform economy brings with it. Questions such as transparency of the markets, freedom of speech and treatment of personal data are in the highest interests of governments. While on one hand, they want to benefit from the positive impacts of the new economy, such as innovation and market growth, on the other they also need to protect their citizens and make sure that all the businesses, digital or non-digital, play by the same rules.

There are already some well-known governmental regulations on digital platform companies, such as the bans Uber and Airbnb have faced. The challenge for regulatory authorities is that the platform economy is moving forward so fast that it seems to have been really challenging for governments to keep up with the development. The public consultations initiated by the European Commission and the UK House of lords at the end of 2015 reveal how governmental institutions are in a desperate need for new tools to tackle the problems they are facing.

One important question is if some laws challenged by digital platforms should be repelled and whether some actual new regulation is needed instead. While some new regulations seem to be necessary, it should be discussed which kind of regulations (local, national, multinational) would be in order.

Concerning digital platform companies, the laws on data are especially important. Digital platforms exploit a huge amount of data, including personal data. This raises new issues that previously have not been taken into consideration by regulatory authorities. In addition to the protection of personal data, issues such as the portability of data over platforms, the rules of open data and copyright questions need to be addressed. These issues are still a largely pristine area that governments and digital platform companies are expected to strongly debate on.

It is difficult to forecast how these regulations will shape up in the future. What can be said for sure is that some governments and areas will be more digital platform friendly than others, and that is likely to be an increasingly meaningful factor for the companies when choosing a location.

3.3 Financial Incentives and Taxes

The relation between financial incentives and taxation to company's location decisions has been a popular topic as an individual factor in the literature, which is why we feel it should be discussed in its own subchapter. While the studies on taxation have become increasingly sophisticated over the years, they tend to yield conflicting results and offer little guidance to policy makers trying to fine-tune tax rates and employ tax incentives for regional economics [30]. Although tax incentives might be useful for companies, in some locations it cannot be specified for which businesses in which locations. Nevertheless, they were found to have an overall positive effect on attracting new establishments, especially in retail and service industries in a local area [31]. At a national level, [32] notes that the Greek government's financial investments were not particularly important in deciding the location for an industrial plant.

However, interestingly, [33] found that while corporate tax rates have no significant effect on company location, the personal tax rates had a negative effect. These results indicate that the impact that high personal tax rates have on the income of the managers and owners affects more on the location decision of a company than the negative impact of high corporate tax rates on company profits.

Digital platforms bring with them new taxation issues for governments. It challenges the traditional income tax base, as the companies are providing more and more services in countries without having a physical or legal presence there. The current tax systems tend to privilege the jurisdictions where the functions,

assets and risks of the companies are actually located. However, there is rising pressure to tax the profit also in the market country, where labor and business factors are located [34]. Digital platform economy has also highlighted the issue that in most societies the existing tax rules are not good at handling all the various part-time activities (such as short term contracts, part-timers and self-employment) that are typical for the platform economy. In addition, such scandals as Panama Leaks have brought to light how many international digital companies are highly involved in aggressive tax planning practices that are now under investigation.

Thus, even though it could seem that taxation would not be a big issue for digital platform companies, its importance is growing. Just as with other political factors, there will be some governments that are more digital-platform-friendly than others, and that will affect the location decisions. In addition, in the future, with the development of artificial intelligence (AI) and other substituted human labor, it is likely that traditional taxation system will not provide enough income for governments causing it to face serious challenges. It is not far-fetched to think that the whole taxation system needs to be reinvented, and that would be a process where digital platform economies potentially play an important role.

3.4 Quality of Life and Personal Motives

Presently, "soft" factors, such as quality of life, image of places or private reasons has become more important for location decisions [35]. Studies in the 90's show that companies evaluated amenities with respect to the likely residential locations of their employees [36]. This, in turn, affected location decisions as they contributed to wage rates, land values and other costs [37]. For high-tech companies' factors, such as cost of living and housing, community issues, environmental quality were important to location decisions than quality of schools, cultural amenities and public safety [38].

Quality of life has emerged as one of the most important 'soft' location factors [39]. Early studies showed that rural business owners living in the region for more than 5 years regarded quality of life with higher importance than newcomer business owners [40]. Also in smaller companies that are relatively footloose and have few staff with a high proportion of professionals, the quality of life was seen as the most important factor [41]. The fast-growing crop of digital platform start-ups are essentially the same. While high-amenity urban locations used to strongly attract labor-intensive industries, they are now the hubs of fervent entrepreneurial activity thanks to the startup-infrastructure, access to professionals and technology it offers [37].

According to [42], social capital is of substantial value and it places strong constraints on an entrepreneur's ability to establish a company in a region in which he does not have connections. Entrepreneurial ventures perform better and survive longer when located in home regions where the entrepreneur has deep roots. The value of social capital is similar in magnitude to the value of human capital like having prior experience in the industry entered.

A high quality of life and personal motives are increasingly important for digital platform economies, but in a different way than before. Firstly, digital platform companies and other startups tend to locate near to each other, usually preferably into so-called hubs. Many cities are establishing and developing this kind of startup-friendly hubs to attract companies locate within their borders. Secondly, while earlier research focused on the interests of the entrepreneurs themselves, digital platform companies are more and more interested in the aspirations of their workers. This is connected to the phenomenon of "liquid workforce": a highly adaptable pool of people with transferable skills working in rapidly changing teams to suit the company's goals. Such workforce is precious for digital platform companies, and to attract and retain the best of the best a company needs to convince the employees they want to work where the company is located. This seducing is a lot easier in an environment that has a high quality for life.

3.5 Other Factors

Some other factors that have gained attention in the literature include Business Climate [43-46] and Infrastructure [47-49]. In the wide selection of studies on the subject, the multiple business location factors defined had been classified in various ways [12]. For example, [50], followed by [51] sorted the factors into three groups: "firm internal" factors (e.g., organizational goals, growth rate of turnover, profits), "location" factors (e.g. distance to customers and suppliers), and "firm external" factors (government policy, technological progress etc.). On the other hand, [40] created a completely different way of categorizing the factors by dividing them into four groups labeled "economic", "qualitative", community" and "recreation".

3.6 Summary on Geographical Expansion

Most of the literature about business location factors is related to the choice of location when starting a new company. However, geographic expansion is a common strategy utilized by many companies to achieve their growth objectives.

This is especially relevant for startup companies that are aiming to attract investors and scale up.

According to [52], geographic expansion involves a unique set of managerial challenges and adds a layer of complexity to company growth. These challenges can be attenuated with planning, by recruiting qualified personnel to staff expansion sites and by networking in the expansion site location. An empirical study on "First geographic expansion of startup firms: Initial size and entry timing effects" in [53] claims the three following findings: 1) Large companies generally have more tendency to expand successfully since they have more resources and capabilities. 2) Late entrants face stronger pressure to grow and are forced to catch up the competition by expansion. 3) Despite entering late in the industry, a large company may create a favorable niche.

In summary, most of the aspects that defined a traditional industry, although still impactful, diminish in importance for digital platforms and their growth prospects. Some other factors are of no consequence at all. Fig. 4 illustrates the factors that affect the expansion of digital platforms, similar to Fig. 3.

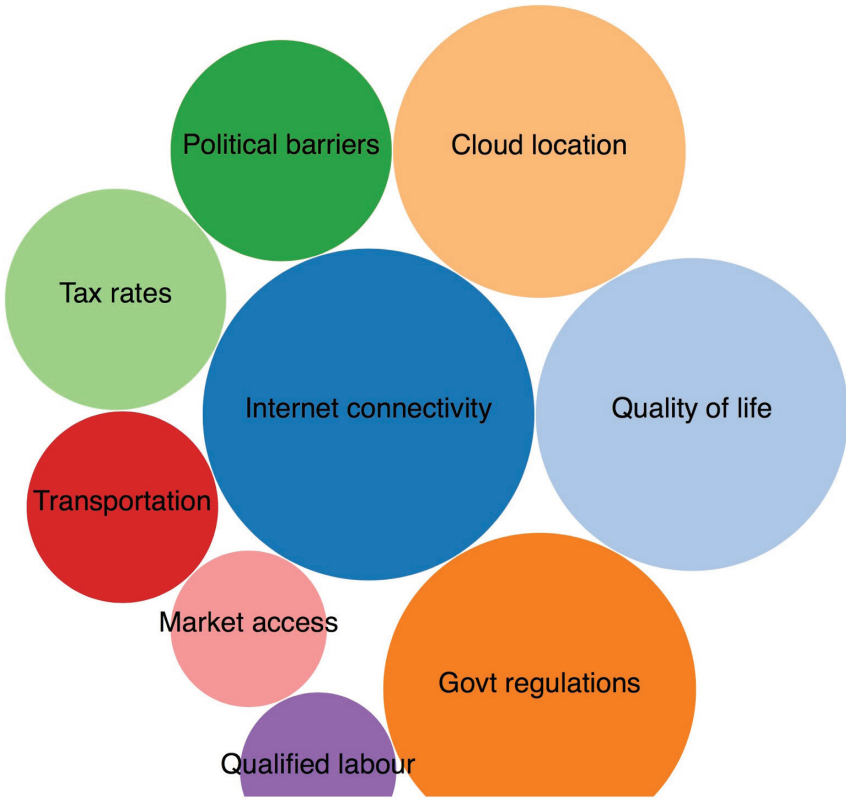

Fig. 4. *The main factors affecting the digital platform economies. The importance of the factor is proportional to the size of the bubble.*

Even though traditional factors, such as good road infrastructure, are somewhat important for digital economies, they come secondary to the internet infrastructure. Road transport rises to prominence in cities or regions where there are platforms generating revenue through deliveries. Governmental regulations and tax rates are likely to increase in effect. Quality of life at a location determines how likely it is a company will attract qualified workforce. In addition, since data is the raw material and byproduct of the digital platforms, and a highly monetizable entity, the location of data is important. The location of cloud and its security then becomes vital for digital platforms. Of course, internet connectivity, data transfer over cloud, government policy making and financial incentives are all interrelated and have overlapping spheres of influence.

4 Case Studies

This chapter discusses the three digital platform companies from three different market sectors, and analyses their business model and its dependence on location as a factor in its success and expansion. The companies studied are ResQ Club, Claned and Sharetribe, which were founded in Finland within the last 5 years.

4.1 Case 1: ResQ Club – Application Fighting Food Waste

According to [54], every year about one third of the food produced annually for human consumption goes to waste. The public is increasingly aware of this issue and it manifests in the emergence of platforms and services aiming to battle food waste with any means possible. One such is the Finnish app (service) ResQ [55] that "rescues" valuable food that runs the risk of being trashed at food businesses. It enables the sellers to generate revenue from the unsold portions and at the same time earn social acceptability by actively battling food wastage. Consumers, on the other hand, get affordable quality for reduced prices and perhaps a sense of satisfaction at having contributed to the cause.

Company Outline. The ResQ application is developed by a young, fast-growing Finnish company ResQ Club. The service was launched in Finland during early 2016 and has since expanded rapidly, both locally and internationally. In less than four months since its launch, there were over 17 000 registered users and thousands of food portions rescued every week. Presently, ResQ club has already expanded to Sweden and Netherlands and keeps growing.

Product Outline. ResQ relies on the demand volatility of perishable menu items during the day at a food business. In big cities with cafés and restaurants

that run both breakfast and lunch services, there would be usually leftovers at the end of either service. Most of this food in different stages of cooking have low shelf life and if not sold on time must be trashed; which spells money down the drain for the business. ResQ identifies the opportunity here and allows the owners to advertise the outstanding meal portions for take-away to customers at 40-70% discount, thus securing a win-win situation for all parties concerned.

Key Features: The service is available as a free downloadable iOS and Android application. Upon user registration, the application uses location services to identify restaurants linked to the ResQ service close to the user's current location. The user can then make their choice from the listed offerings based on proximity and price. Each meal has a latest pickup time listed (to ensure food quality) and once it is reserved, the restaurant readies it for pickup.

Business Model. ResQ Club's revenue comes from commission charged on the monthly sales made by the restaurants through the ResQ platform. The selling price per meal is usually set around 3-8€. The price limit is important to manage the availability and to ensure the attractiveness of the service. The leftovers must sell at relatively lower rates than those at regular cafés or restaurants, or else it loses its appeal with the customers. However, it is still unclear how the ResQ service can assure customers that the restaurants are not excessively exploiting the opportunity and selling at undiscounted rates. Additionally, the prices are somehow normalized across all restaurants. If individual pricing is encouraged, the aim of food rescue shifts from an environmental goal to an exclusively profit-making one. Nevertheless, the restaurants only stand to gain by collaborating with ResQ, unless they are already participating in other food sharing programs. The only additional cost they incur is in take-away packaging, which is not much.

Location Dependency. The amount of food wasted varies greatly depending on the location. In some countries, wastage happens along every step of the production chain - harvesting, processing, and delivery. This can be attributed to poorly developed infrastructure like lack of refrigeration, ineffective packaging, unsanitary conditions, and inadequate market facilities. In low-income countries, these contribute to cause food to spoil much quicker. In such economies, food prices also tend to be lower. For ResQ it is more sensible to set up in more high-income urbane neighborhoods since the returns are higher.

Limited to urban locations: ResQ needs an urban setting to function successfully. In a small town with only a handful of business owners, unsold portions of a variety of food offerings cannot be guaranteed. Variety is important because when the prices are comparable, customers are encouraged to try 'something new'.

Expansion: ResQ Club say on their LinkedIn page that they are all the time recruiting "agents" in other towns to become ResQ's representatives. These lo-

cal agents could be instrumental in making liaisons with local businesses and also in scouting competitors like Too Good to Go (TGTG) (founded late-2015 in Denmark), which also shares the same concept except they provide their own, environmentally friendly take-away packages. In January 2016 TGTG expanded to UK and are now present in six different countries as of August 2016. Understanding the peculiarities of the new market and its population is also crucial. This is important especially in expanding to new countries or regions, which can be very different culturally.

Cultural barriers: Food is an integral part of the cultural fiber of a populace. Failure to realize this resulted in the debacle ResQ faced in Netherlands which does not have a popular daytime buffet culture but instead a habit of sandwiches. Since the latter is considerably less perishable and easily assembled, restaurants/cafes do not feel compelled to sell their surplus at heavy discounts.

4.2 Case 2: CLANED – Smart-Data Learning tracker

It is without doubt that the advances in technology propel new learning trends to the forefront. While the proliferation of electronic media played a huge role in disseminating knowledge to the masses, the mutual engagement in learning and teaching had to wait until the advent of MOOCs (Massive Open Online Courses). Riding on the increased access to computers and internet over the world, the first such MOOC was introduced in 2008. MOOCs employ various kinds of multimedia and network resources like social networks, coding platforms and shared learning spaces to engage students. Several MOOC platforms like Coursera and EdX have been very popular in that respect, but presently they operate on for-profit basis.

The global education market is, hence, a burgeoning one, growing at a reported 7% annually and estimated at 3300 billion euros currently [56]. The advances in this market go hand in hand with the growth in education technology which itself is estimated at over 100 billion euros and predicted to grow by more than 20% per annum in the future, especially in emerging markets like India and China [56]. According to a research report by NOVONOUS, big data in particular has a key role and presents huge opportunities in this sector, with a compound annual growth rate of 10%. Education industry is thus, the next in line to be disrupted.

Company Outline. CLANED Group is an educational startup, founded in Helsinki, which started operation in June 2013. They started selling their product CLANED to customers since September 2015, which they claim to be the world's first such product to employ learning analytics and data crunching to provide learning solutions. Currently, there is a team of 20 working behind

CLANED and its operations have expanded to London, Shanghai and Singapore. First web version of product was launched toward the end of 2015, later followed by a mobile application.

Product Outline. CLANED™ developed by Claned Group Oy is a smart learning tracker that offers an open, personal learning space and a supported ecosystem for learning. It is a product as well as a platform for smart and effective education in higher educational sector. Data mining, learning analytics, AI and pedagogical science form CLANED's basis. The algorithms powering the smart learning data are based on research from University of Helsinki and MIT, USA [57]. They measure the learning interactions between the materials, peers and teachers and shares it freely with students, educators, content providers. The valuable insights this provides results in a reliable metric capable of maximizing learning output.

Key Features: CLANED learning tracker enables the user to access or upload unlimited educational content, to create study plans, and follow it with various learning tools. With a collaborative chat interface, data regarding the student's motivation, emotion and stress levels are also collected. Thus for individual learners, CLANED specializes in generating real-time feedback, tangible measures of performance, and individually optimized future learning paths. For educators, the tool is very promising in terms of assessing the effectiveness of study materials, redesigning and sharing courses, identifying poor learners and assessing ways to support them. For organizations, CLANED works at a broader level by analyzing information flow at the company level and generating statistics regarding materials sought after by different employee groups, and identifying the dynamics of peer-peer knowledge transfer.

Business Model. The company identifies schools, municipalities, corporations as their key customers. The revenue comes by way of annual subscription fees and commission charged on educational material purchases, including self-generated content. CLANED recognizes the huge advantage it holds being a Finnish education brand, and aims to capitalize on it by building a strong international customer base and trust among clients whom they select after careful screening. They value credible clients who can in turn vouch for CLANED's credibility, which is vital to their future scaling prospects. Their current clients include United Nations and Oulu Business School among others. To build a strong base in Finland, they are already involved in professional training in 200 Finnish schools with the CLANED platform and predict that their solution will reach 80 % of all Finnish schools and teachers.

Location Dependency. At the solution level, the crux of CLANED learning tracker lies in the digital domain, in its data analytics and AI algorithms. However, at the business level, CLANED is heavily invested and interested in

working with local municipalities for teacher training. In Australia CLANED is collaborating with Catholic Schools of Western Australia to benefit around 13 000 teachers and 73 000 students. It has forged partnerships with consultancy specialists in India for corporate training. This geographically widely distributed client list of CLANED is veritable proof that location is no longer a prohibitive factor in the Edtech industry. Nevertheless, the following location factors are still relevant.

Internet Connectivity: There exists lacunae in education technology, particularly in the lack of emphasis on user experience. CLANED identifies this and focuses on providing personalized learning and teaching services for its users. A reliable and high-speed internet is thus important to ensure the best user experience, at least for CLANED's individual users, as there is a lot of educational content to be accessed from the cloud and feedback to be provided from the software layer. For corporate customers, this is not a problem as they already have their internet infrastructure secured.

Cultural barriers: While CLANED customizes its solutions for it bigger customers in teacher and personnel training, in order to capture the individual learner customer base in markets like India and China, CLANED has to generate and tailor its educational content suitably. Students from some regions may prefer technical studies to business or arts. Therefore, it is important to understand these specifics to get a strong foothold in a new demographic. In addition, multimedia content in the local languages have to be created.

4.3 Case 3: Sharetribe – Digital Marketplace

Digital markets are new drivers of retail economy; a staggering amount and variety of goods are now bought, exchanged and recycled over the internet. As per the Internet Retailer 2016 Top 500 Guide, 10.6% of US retail sales in 2015 worth $3.22 trillion came from web sales. This is in part thanks to online marketplace giants like Amazon and eBay where multitudes of merchants - both top and small retailers have pitched their tents. The presence of big retail chains on such platforms is at times a bane to smaller sellers who get overshadowed. This prompts many of them to move to different marketplaces like Sears and Etsy. While such marketplaces targeting specific niche, categories are in vogue, setting up one such e-commerce website is a tough task. This is where Sharetribe rises to prominence. It is a "one stop" shop for anyone looking to set up an exclusive online marketplace. It offers Marketplace-as-a-service (MaaS), with a search engine-optimized, domain portable, ready-made and yet customizable platform suitable to one's marketplace concept.

Company Outline. Sharetribe was launched by a Finnish startup Sharetribe Oy that is based in Helsinki, Finland and founded in 2011. Presently, the team comprises 15 people. Although currently Sharetribe offers only a web browser based hosted solution, they plan to release an Application Programming Interface (API) that would allow customers to build a complete mobile application.

Product Outline. Sharetribe is an open source, commercial, for-profit online service, which enables an easy way to create online marketplaces where users (companies as well as individuals) can sell/share items, services, or other resources in a trusted environment. It is essentially a tool for creating marketplaces, just as Wordpress is for creating blogs. It enables the setting up of any kind of marketplace: peer-peer rentals, niche marketplaces, booking services [58]. The fundamental idea is to enable everyone to set up his or her own platform without any required coding experience. The Sharetribe platform is also available as an open source code through GitHub for those who can improve the code and hosting the service themselves.

Key Features: Transactions are enabled through built-in payments systems and the owner of the marketplace can actively moderate the community. Interestingly, Sharetribe claims no ownership of the digital data being generated. It is the marketplace owner's property, which they are welcome to crunch with Google Analytics. Thus, Sharetribe's role is limited to taking care of the core back-end framework of your marketplace, at relatively affordable rates.

Business Model. Depending on the number of users to be hosted on the marketplace, Sharetribe charges monthly fees from 99-299$ from the marketplace owner. It is the owner then, who charges a commission fee from all transactions in his Sharetribe supported domain. Domain ownership, and brand building are other add-ons available for purchase. According to Sharetribe CEO Juho Makkonen [59], they have 560 paying customers in 50 different countries as of May 2016. Successes built on Sharetribe include Studiotime (the largest online community to rent music studios), Häätori (marketplace for pre-owned wedding dresses), and The Quiver (marketplace for peer-to-peer surfboard rentals).

Location Dependency. With a team co-located in Finland, Sharetribe Oy has been able to launch and support online marketplaces conceived in one part of the world and which now have listings from all over the world like Studiotime. Competitor companies such as Arcadier, Cloud Commerce factory are similar to Sharetribe in this respect. Thus, on primary analysis, Sharetribe as a digital business does not reveal a dependence on location. However, it promises to support its customers all 7 days a week, which would either mean they have optimized their job delegation within their team in compliance with Finnish labor laws, or they have personnel located elsewhere. Nevertheless, Sharetribe is a true example of a

digitalized company. It is not directly involved with physical transfer of goods or entities and has minimum to zero human contact with its own direct customers, who can enlist Sharetribe's services with just a couple of mouse clicks. Internet and cloud connectivity are impotant factors still, since Sharetribe, being the marketplace manager, needs to be active and online throughout.

4.4 Case Studies Summary

The more we analyze companies operating exclusively in the digital domain, the more location, as a factor, becomes insignificant in their success. While CLANED and Sharetribe and true tech driven solutions, ResQ is more principle driven. There aren't any discernable layers separating ResQ from the true providers (restaurants) and the paying customers; hence, any factor which affects them has a direct implication on ResQ's prospects. Food cultures vary immensely over the globe, and ResQ would need to customize its approach every step along the way to successfully scale up and stay on top of the competition. Although reliable internet connection and constant access to cloud are the basis to every digital platform's success, for some companies, like CLANED and Sharetribe, it carries more weight. Interrupted connectivity will affect the user experience of both platforms considerably.

CLANED and Sharetribe are many layers separated from the physical transactions. For Sharetribe, the marketplace owner himself is its true customer. The CLANED enabled marketplace for content sharing and purchase is restricted to the digital domain. Therefore, the more digitalized the core operations of the company and the stronger its link to its main revenue stream, the lesser the importance of location as a key factor in its success. Thus, in addition to the literature review the case studies reinforce our suggestions about irrelevance of traditional location theory for digital platform companies. However, due to complexity and variety of digital platforms, a sample of three companies from various domains does not portray the whole picture; but nonetheless, it corresponds with the overall trend.

All the cases studied have one thing in common- they are all founded in Finland. This made the location analysis in terms of the prospects of expansion easier. However, it also raises the question of whether these companies enjoyed any specific advantage, from being founded in Finland. CLANED at least, from their mission statement claim that being a Finnish educational tech company adds to their reputation since Finland is respected the world over for their pioneering school and university education system. However, as far as ResQ or Sharetribe are concerned there seems to be no specific reasons, apart from that their startup

ideas were novel to the Finnish market. Other firms with similar business models exist in Europe and elsewhere. Nevertheless, the social capital and the startup infrastructure available and unique to Helsinki would have been an important factor in their founding location decision.

5 Discussions

The choice of company location has been a critical decision to the success of companies throughout the history. Relevance of location has been also an important question for researchers for more than fifty years. Traditional set of factors, like proximity to raw materials, access to market and supply of labor have started to lose their significance as more factors have been introduced through the years. Most surveys conducted seem to be focused on traditional industrial and manufacturing companies that are depending on the flow of physical material. However, so called 'soft' location factors like quality of life, image of places or private reasons have become growingly important to modern companies, especially within high tech industries.

Little research has been conducted on how location factors apply to digital platform companies. Additionally, the factors that work for the traditional value chain businesses fail to capture the essence of the digitalized era, and would need a major redefinition. We believe that some of the factors, especially relevant for high tech companies, also play a crucial role for digital platforms. In addition, factors such as access to markets are still important yet less relevant for platforms than for traditional supply chain based businesses. In addition, some factors that have not been very well recognized in the literature are crucial for digital platform companies, such as internet access and both mobile and landline online communication infrastructure.

General Critique towards Factors Research. None of the researchers seems to converge to the same conclusions even when studying the same industries, the same business categories or even the same set of factors. Most of these are empirical studies and a major problem with such surveys is that they are affected not by facts alone but also subjective perceptions. Entrepreneur's location decisions vary depending on type of business, current location and regional differences, location criteria (willingness to move) and constantly evolving conditions. Another problem is that it is hard to draw conclusions since the location studies are commonly restricted to particular research context such as a specific type of industry, business category or same fixed set of factors. Moreover, these surveys rarely explain why particular behavior of a company was observed as a

basis for a factor. Additionally, they usually focus on a certain area, a country or a region, which is not helpful in terms of global markets that especially digital platform companies must target when aiming for success.

Government Policies. Government regulations are becoming increasingly important; especially in the case of platforms which introduced radically new ways of revenue generation like Uber or Airbnb. Their involvement and the general societal impact of the business are very different. This has raised issues and questions regarding the firm's accountability and its responsibilities towards their stakeholders. Therefore, it has pushed local and national governments to revise their policies to try to include the platform economies. In particular, it has been in the policy makers' interests to protect the workforce's and the consumer's rights. As per a recent landmark ruling in the UK, Uber's drivers are to be considered its employees, and the company needs to grant them their basic employment rights. Similarly, in many cities, hotel rentals have dropped since more and more locals started hosting through Airbnb. Moreover, Airbnb's model exempts it from paying hotel taxes. This has led to local lobbying and pressure from hotel chains in some US states to ban Airbnb listings. Recently, New York has banned short-term listings on Airbnb citing how it exacerbated the housing crunch faced by those seeking permanent housing in the city. It is likely we will see more of such bans in the future as governments are struggling to handle the new economy.

Location of Cloud. Additionally, government regulations in terms of data storage has become stricter. With the pervasive nature of platform services and the large amounts of data being gathered, many countries may forbid foreign companies from gathering, saving and using data regarding their citizens on servers located outside their borders. For example, in Russia and China, a company is not authorized by law to store personal data about citizens outside of the country. This restricts the location of company's physical cloud computation or storage assets as well as registered users to within the country. This limits the freedom of digital platforms in terms of location and security of cloud.

Cultural Impacts on Location. Digital platform companies do not usually need to respect national borders, but to succeed they do need to understand cultural borders. From the case studies, we see that the expansion prospects of ResQ and CLANED have cultural dependencies. Food culture varies within and across national boundaries. Therefore, digital platform companies working in the food domain should analyze this before expanding their operations. In addition, to function successfully, a company needs to capture certain markets. For instance, there is a massive market for online courses in India. To capitalize on this market, a platform like CLANED must build their portfolio of courses in accordance with the nature of existing demand. Understanding the customer base and adjusting to

its requirements is expected of any digital platform economy looking to expand and overcome cultural obstacles. The large amounts of customer data gathered can throw some light in this direction.

Limitations and Shortcomings. Various platform companies from the same domain operate through different business models, and respond differently to a variety of location-linked factors. It is a complicated task to correlate these links between a variety of platforms and factors and to arrive at a general trend for business location choice. The complexity that we faced in our approach might be the underlying reason for the nonexistence of such research within the literature of location theory. However, such a study for digital platform economies is novel and beneficial; conducted on a larger statistical scale, it can reveal hidden patterns and future trends of the present-day phenomena.

5.1 Future Trends in Digital Platforms

Artificial Intelligence. Several emerging trends in digital technology including advances in cloud computing, AI and virtual and augmented reality will affect the future relevance of location for digital platform companies. The rapidly evolving quality of internet enables the sharing of computational power and digital storage capacity from anywhere in the world. Other emerging platform enabling-technologies include Neuromorphic Hardware, Quantum Computing, Blockchain, IoT Platform, Software-Defined Security and Software-Defined Anything (SDx) [7].

Future advances in AI will make it possible to replace human labor with intelligent automated systems. Machines with AI are going to be the new "co-workers", which will empower the workforce and help people achieve new levels of productivity. Recognizing this potential, investors and companies are investing more and more into AI research, in an effort to automate as many tasks as possible. Examples are plenty, from image recognition software to AI platforms, such as Amelia from IPsoft that offers you a digital worker for your office, for customer support. It understands the logical conversations, is emotionally engaged and speaks 20 languages [60]. Such advancements make it easier for platform companies to expand to new markets, without even recruiting personnel in that specific country.

New disruptive trends and challenges for Governments. AI is quickly expanding to other businesses, for example car industry. Google has logged more than 3 million kilometers during the testing of driverless cars. They were involved in only 11 accidents, of which none were the fault of the driverless vehicle [61]. Arguments for the safety of driverless cars are based on the notion that automation removes the human aspects like fatigue, distraction, deterioration that cause crashes in the first place:

Improvements in AI technology in car industries may induce new challenges to revenue creation. With the shift to driverless cars, apart from fewer accidents, there probably will be a lot less personal cars in the future. Thus, there will be a significant cut in the money flow coming from all aspects of driving. To start with, this includes car and road taxes, and all sorts of tickets from traffic violations. In one year, the city of Los Angeles generates around 161 million dollars from parking violations alone [61]. Improvements in safety means that all the parties that profited from the cash flows as a result of traffic accidents will also feel the disruptive change. The first affected will probably be the insurance companies, lawyers and hospitals. Yearly, hundreds of dollars are generated from poor driving behaviors. Thus, driverless cars are poised to becoming a future disruptive phenomenon. The immediate implications of the substitution of robots with AI for routine tasks and jobs are not straightforward. Perhaps, from the government's perspective, changes in the taxation system would become a necessity. From the point of view of entrepreneurs, the primary focus is on cutting unnecessary expenses in the most efficient way, by following and implementing the technological advancements.

A Need to Change for the Companies. For established organizations, such new technologies with their inherent disruptive nature also provide an opportunity to transform entirely. The key to this transformation is the workforce, which has to evolve in tandem with the emerging trends in order for the company to edge out the competition. A big step towards this is by taking into use collaboration tools and cloud-based workflows to empower "anytime, anywhere" working. This makes efficient remote work possible and allows distributed teams to collaborate in virtual spaces, which exist independently from the true physical location of their offices. So companies are investing in personnel training to capitalize on all these advantages to nurture and attract a 'liquid workforce'. Currently, digital training platforms that combine enterprise-developed learning along with MOOCs into a single curriculum are one major area of investment. An agile workforce means an agile business [10].

6 Conclusions

Digital platform economies are spearheading the digital revolution. The internet and the cloud are the foremost enablers of digital platforms. The availability of internet access is increasingly being regarded as a vital necessity all over the world. It is closely related to the freedom of expression and assembly of an individual and Intentional disruptions and restrictions placed on the internet access in a country/ region is considered unethical and condemnable.

Internet and digital connectivity is becoming a staple part of life for larger and larger numbers of individuals in the world's population. According to the International Telecommunication Union, although the percentage of internet users varies over different regions of the world, the growth pace is steady all over. Revolutionary changes and solutions in shopping, education and entertainment have the customers constantly engaged. These solutions are built on platforms, which are swiftly displacing incumbents and revolutionizing the way people interact and transact.

While location as a limiting factor to trade is crumbling thanks to globalization, communication and digital revolution, bureaucratic and legislative factors rise in prominence. Some labor could be completely virtualized and, thus, independent from physical location. The relevance of location has also changed. Traditional factors have diminished or transformed and consequently, new factors have emerged, including reliable internet access and location of cloud database.

Furthermore, the case studies revealed that the location factors affect each of the three companies differently. Their dependence on location is a direct reflection of their business model and revenue stream. The further removed the company's value creation is from physical exchanges, the better insulated it is from location based changes. In addition, we see that digital platforms from different domains have variable dependence to location. In our analysis, the dependence was most for the food business, lesser for educational tech sector and the least for the Marketplace as a Service provider.

The blood and pulse of any digital platform economy is the data. It is generated and stored as a direct or indirect consequence of the myriad exchanges that happen as part of the platform's activities. It is a valuable and a challenging asset at the same time. Concerns about data security and sensitivity has put governments, business owners, individuals in flux. The world is coming to terms with the explosive changes and we are at the cusp of this transition.

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Can Social Enterprises Be Born Global?

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ABSTRACT. *Social enterprises are social businesses that directly address a social cause through their business activities. The key to these businesses are their social, cultural, economic, and environmental or health missions that directly benefit the society or communities. Although many problems that social enterprises try to address, such as poverty, gender inequality, and environmental degradation, are ubiquitous, the demographics of the population affected by it change from place to place. Thus, while there can be social enterprises serving the interests of a unique demographic, there exists a big opportunity for social enterprises that wish to make a global impact. As with any start-up, social start-ups have to choose between being born global or dying local. Also to be seen is if it is easy for a social business model to be born local and then scale up. This paper explores if and how a social enterprise can successfully reconcile the social motive with the profit motive to build a sustainable business model that can propel it to a global platform. We assess the particular niche occupied by social enterprises in the entrepreneurial world and, through case studies, investigate their revenue flows, business models and challenges they face in the form of government regulations or other local agents.*

KEYWORDS: *born-global, social enterprises, social busines*

1 Introduction

The past seven decades have seen a remarkable change is the global socioeconomic spectrum. We witnessed the fall of colonialism and communism, the spread of globalization, the prevalence of capitalism, the boom in communication, and the rise of digitalization. We are at the cusp of many disruptive changes that have been propelled by the rise and fall of the megatrends of the future and past. The world population has never been wealthier and healthier, and our numbers continue to increase. In spite of the positive direction in which we generally seem to be headed, we still face the same problems that have persisted over several decades.

Poverty and the social and ecological problems it engender continue to be a constant. UN agencies, donor nations, and various aid organizations have all tried for more than 50 years to do their best in this regard. Despite their best efforts, the outcomes have not met their expectations, which has encouraged a change in the way these issues are approached. In the past three decades, there has been a continuous evolution in the traditional social and economic roles of private businesses, government institutions, and nonprofit organizations. Social enterprises have emerged at the center of this change to encompass this diverse set of activities.

While many social enterprises have had success locally, they still face challenges to scale and become global players. This is perhaps due to the inherent nature of social business models and/or due to the specificity of the issues they deal with. If being localized is too restrictive, it is perhaps beneficial to start out with a global strategy from inception, which is referred to as *being born global*. In this work we discuss the true nature of social enterprises and the potential for a global wave of societal change. Section 2 discusses the traditional roles of for-profit and nonprofit organizations, followed by an overview of social sector organizations in Section 3. Section 4 examines a couple of such organizations with the aim to assess and understand the various traits and operational features that qualify them and others as social businesses. Section 5 discusses scaling social ventures and the practical strategies to undertake in order to establish a multinational presence. The findings and conclusions from these discussions are summarized in the final section.

2 For-Profit vs. Not-For-Profit Organizations

A for-profit corporation aims to earn profit through its operations and is concerned with its private financial gains. This type of company usually does not

receive government aid and may engage in myriad businesses. It works for its own business interest first, which becomes its basis for decision making. Its leadership has the free choice of making investments and decisions that will generate the greatest revenue for the business. While such corporations are capable of growing quickly, they may not necessarily need to employ more people to do so. Large multinational corporations are led by their top executives and directorial board, with the owners or founders choosing to maintain a separate identity in many cases. Companies with high turnover are also publicly traded, making a percentage of the company's ownership purchasable. In such big companies, top-level executives and directors are not usually required in their personal capacity to satisfy any debts that the company might owe.

As these organizations aim to maximize profit, they can be very healthy for the economy as the more they earn, the greater is their tax contribution. While their higher productivity contributes to the GDP of any country where they are producing in, a strong commitment towards social welfare in their policy making has been largely absent until recent decades. Multinational corporations overlooking fair labor practices and environmental regulations in their factories in underdeveloped nations have been a prominent concern. Garment factories in Vietnam employ women who work 12 hours a day, 6 days a week, and still struggle to get by on the $1 an hour they earn making clothes for some of the world's biggest fashion brands. Inability to monitor subcontractor practices and income disparities it fosters have drawn flak for these corporations. Corporate tax dodging costs poor countries at least $100 billion every year, an amount sufficient to educate the 124 million children who aren't in school and to fund healthcare interventions that could prevent deaths of at least 6 million children every year. The irony is that the majority of the world's population works tirelessly to produce a range of products and services that they themselves can't afford.

However, new models are being established in which private entities are gravitating toward a community-serving goal. One prominent example is the format of B-corporations. These are modern for-profit corporations that demonstrate a strong social commitment. The B certification, which stands for beneficial, is issued by a nonprofit organization called B-Labs indicating that certified organizations voluntarily meet certain standards of transparency, accountability, sustainability, and performance, with an aim to create value for society, not just for stakeholders/shareholders.

A **not-for-profit organization** (NPO) is an organization dedicated to furthering a particular social cause or advocating for a particular point of view instead of making a profit. A nonprofit organization is restrained by the non-distribution

constraint, which means that such organizations use their surplus revenue to further their purpose or mission rather than distributing it to the organization's shareholders (or equivalents) as profit or dividends.

The nonprofit landscape is highly varied and usually associated with charitable organizations. Although charities do make up an often high-profile and visible aspect of the sector, there are many other types of NPOs. Overall, they tend to be either member-serving or community-serving. Member-serving organizations include mutual societies, cooperatives, trade unions, credit unions, industry associations, sports clubs, retired servicemen's clubs, and advocacy groups or peak bodies. These organizations benefit a particular group of people, the members of the organization. Typically, community-serving organizations are focused on providing services to the community in general, either globally or locally, including organizations engaging in human empowerment projects, aid and development programs, medical research, and education and health services. It could be argued many NPOs sit across both camps, at least in terms of the impact they make. For example, a grassroots support group that provides a lifeline to those with a particular medical condition could be deemed to be serving its members (by directly supporting them) and the broader community (through the provision of a service for fellow citizens).

Designation as a nonprofit does not mean that the organization does not intend to make a profit but rather that the organization has no "owners" and that the funds realized in the operation of the organization will not be used to benefit any owners. Some governments set limits to the profit utilization of registered NPOs and offer tax exemptions in turn. Most countries also have laws that regulate their establishment and management in compliance with corporate governance regimes. Larger organizations are mandated to publicize their financial reports detailing their income and expenditure. Organizationally, both nonprofits and for-profit entities both have board members, steering-committee members, or trustees who owe the organization a fiduciary duty of loyalty and trust. Thus in many aspects, they are similar to corporate business entities though there are often significant differences.

The absence of a singular profit motivation raises the concern of the financial sustainability of an NPO. Most of these organizations often depend on a steady flow of donations for their smooth operation. Such donations made to these organizations represent a major form of corporate philanthropy. Another affliction of a NPO is founder's syndrome or founderitis, which is a popular term for the difficulty faced by organizations where one or more founders maintain disproportionate power. They may influence the effective initial establishment of the project, leading to a wide range of problems for both the organization and those

involved in it. The passion and charisma of the founder or founders, which was such an important reason for the successful establishment of the organization, becomes a limiting and destructive force, rather than the creative and productive one it was in the earl y stages. This downward spiral occurs in both not-for-profit and for-profit organizations. It may limit the further growth and success of the project and/or lead to factionalism and divisions as the scale of demands made on the organization increases, eventually resulting in failure.

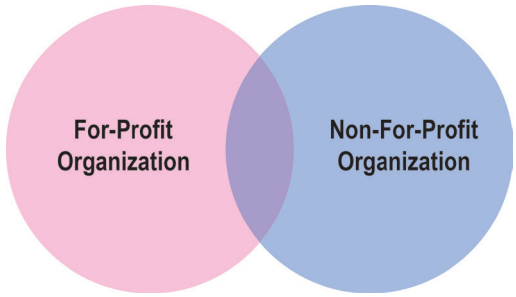

Fig. 1. *Classification of corporations into two broad spectrum.*

3 Social Sector Organizations

Social enterprises (SE) have a mixed heritage, which complicates efforts to give this category a holistic definition that differentiates it from nonprofits, cooperatives, and for-profit enterprises and advocates for the special niche it occupies in the entrepreneurial world. This section explores the concept of social entrepreneurship and tries to infer whether this concept is just a nuance of terminology differentiated solely by revenue and legislative norms or whether these organizations have a role and purpose to play that goes above and beyond the paradigms of traditional nonprofit and for-profit enterprises. We also examine research on the theory behind SEs and summarize the different definitions of social enterprises present in current literature.

3.1 Background

The wider social entrepreneurial movement began in 1980s when nonprofit organizations, in a bid to diversify their funding streams, started exploring possibilities to create business ventures. This trend slowly led to the coining of the term *nonprofit entrepreneurship*. This was followed by the founding of Ashoka in 1981 to aid such “public entrepreneurs,” who later came to be called “social

entrepreneurs." From then on, social enterprises have emerged as the accepted format to describe these new wave of ventures that were seemingly branching off from the traditional roles of nonprofits but at the same time creating social and commercial value. *Social value* or *societal wealth* refers to anything that contributes to the growth and well-being of society or community. It could be cultural, educational, environmental, or intangible assets like trust, relationships, collective mentality, better risk handling, self-esteem, and skill development.

While the roots of social enterprises or social businesses were of philanthropic nature in the United States, in the United Kingdom, European Union, and Asia, this movement began from cooperative ventures [1]. Social enterprises have also been evolving in direct response to the need to empower the marginalized population in situations where government programs came short of delivering their promises and nonprofits failed to create an impact proportional to their massive funding. In some other countries (mostly the Nordics), the presence of social enterprises has been seen mostly through community ventures characterized by democratic process, collective decision making, and shared control of capital and resources. Nevertheless, there is a rising number of social businesses that directly pursue social goals either through economic activities or through charitable projects by way of fundraising.

Definition in Literature

It is thus increasingly evident that social enterprises do not adhere to a particular structure or norm. The general premise of these entities affords a diversity of activities, customers, and markets, which cumulatively effects constructive social change. Social entrepreneurship can be described as a mechanism of responding to social problems through innovations that are transformative and financially sustainable [2] [3].

However, there has been no universally accepted definition of social entrepreneurship. The theory underlying this field is not explicitly defined even in academic circles. A review of the social entrepreneurial literature of the past two decades [4] observes that although the majority approached social entrepreneurship on the basis of various concepts, only very few reported empirical findings. Also notable was the general lack of theoretical propositions for the future. This is perhaps owing to the current transient nature of social entrepreneurship, which resists compartmentalization. Although this could be a good thing, some research [4] insists that in order for the field of social entrepreneurship to progress, it needs clear boundaries, albeit under a construct that is common and yet broad. This will facilitate reliable comparisons and predictive analysis. One such broad outlook [5] offered these observations:

- Social entrepreneurship is a process of creating social value through new resource combinations, whose primary intention is to best explore and exploit opportunities for the same.
- Social value is created by fulfilling societal needs or stimulating societal change.
- The form of social entrepreneurship can involve product or service offerings and also creation of new organizations.

Social entrepreneurship occurs equally well in new organizations as well as in established concerns, which in the latter case, has been called *social intrapreneurship* [5]. This concept is analogous to business intrapreneurship and refers to either new venture creation or entrepreneurial process innovation. A good example of social intrapreneurship would be Unilever's foray into toilet cleaning products in Ghana. While stationed in in Nigeria, Unilever chemical engineer James Inglesby was tasked with finding new business opportunities in toilet cleaning products. Upon learning that 2.6 billion people around the world do not have access to proper sanitation, he built a new business in Ghana, a market new to Unilever. Here, the company worked with local community groups to offer branded, affordable plastic toilet and cleaning service by a local business that uses Unilever cleaning products. Thus, Unilever directly addressed a social problem by creating a business opportunity through an innovative value chain.

Social Role

Social enterprise in its truest essence exists at the nexus of public, private, and nonprofit sectors and exhibits characteristics of each. It tackles social problems that have been traditionally the government's responsibility, in an innovative, risk-taking and transformative manner, just as private businesses do. Meanwhile, social enterprises are open to and rely on voluntary investments of time and money from individuals and other parties, similar to charitable organizations. Social entrepreneurship is being increasingly considered essential to the progress of societies, as entrepreneurship is to economies.

Many trends have broken down the traditional distinctions between private, public, and nonprofit sectors and allowed a convergent space for social entrepreneurship to grow. National and local governments have had the vested role of tackling social problems that are "market failures," where there is an insufficient or underdeveloped presence or complete absence of profitable market opportunity. In spite of the lack of monetary returns, if the rewards come in form of a society-wide positive impact, then the investment is still worthwhile. However, from a private business's point of view, it is not lucrative.

In recent years as more national economies have opened up, private players

have started bidding for participation in sectors such as education and other public services that used to be in the public domain. While this cannot truly be considered as social enterprise, it calls to attention the blurring of the boundaries that had set economic roles apart. Private businesses are also increasingly aware of the social responsibility they hold and have been actively engaging in protecting communities and environments where they operate. Sustainability is the central theme in corporate social responsible (CSR) initiatives. For example, Ben and Jerry's and Starbucks use only fair trade ingredients and sustainably grown products; Google, through its corporate effort Google Green, promotes efficient use of resources; Xerox since 1974 has been encouraging its employees to participate in community-focused initiatives.

Rising national debt and austerity measures have also forced governments to rethink their policy making and spending. The focus is more on delivering efficient market-based solutions. Private companies and nonprofits are increasingly being contracted by governments for this purpose. This is more cost effective and a better use of budget funding. On the other hand, nongovernment organizations that have long enjoyed generous patronage are also faced with the real responsibility of being accountable to donors by maintaining transparent money trails. Having business ventures in their roster brings in revenue, enabling them to be sustainable and thus ensuring the longevity of their operations. All these convergent trends, which are deconstructing the roles of each sector and converging to the common ground of social entrepreneurial activities, are summarized in Figure 2, which expands on Figure 1.

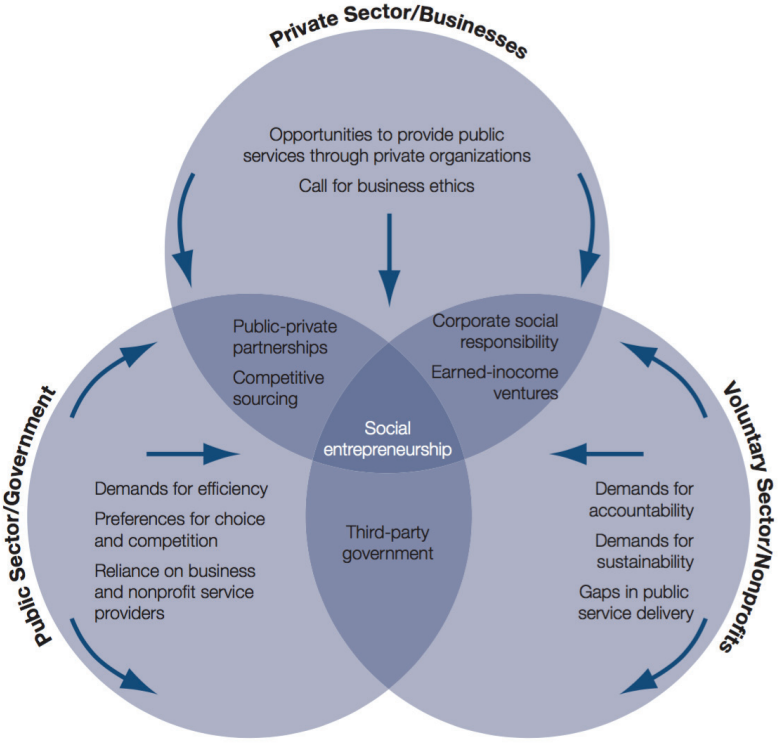

Fig. 2. *Trends in motion in three sectors [3].*

Objectives of a social enterprise

Social enterprises have a commercial activity of some form that creates revenue and also a social goal of primary importance. Some of the common objectives of social enterprises include reducing unemployment, conserving environment, reducing inequality, aiding the underprivileged and socially excluded, empowering a community, and reducing poverty. Essentially they aim to solve social problems and achieve socially beneficial objectives while maintaining a sustainable business model.

3.2 Categorization of Social Enterprises

Social enterprises can be categorized in different ways, depending on various metrics. The 4 lenses of Strategic Framework [6] facilitate the performance analysis of a social enterprise on the basis of four strategic perspectives, which classify social enterprises based on the strength of their mission orientation (see Figure 3) and on the extent of integration of the social programs with business activities.

Based on the motive

For "mission-centric" social enterprises, mission is the foundation of their social programs and the major factor in their operations and decision-making processes. They are usually financially self-sufficient and use the surplus to subsidize peripheral social activities other than their main economic activity. Microfinancing institutions are an example of such an enterprise.

"Mission-related" organizations have a commercial service or product for which able customers pay in full and the disadvantaged ones pay in part. Thus, the revenue generated from their "premiere" customer segment fuels their social goals. When a social enterprise is "mission unrelated," it usually occurs within the realm of an NPO. This means that the social enterprise is not directly involved in the activities that further the social mission of the organization. Instead, it has a separate set of commercial activities that generate an income for the NPO. Thus, the social enterprise itself contributes only indirectly to the social mission.

Fig. 3. *The spectrum of social enterprises, depending on the strength of social motivation.*

Based on business/program integration

When the business activities are embedded into the social programs, the SEs are mission-centric. The business or enterprise activity goes hand in hand with the social impact it delivers. The target population makes up 100 percent of its clients as well as consumers, or sometimes even owners and employers. The economic and social activities are thoroughly symbiotic processes and makes for a sustainable business model. On the other hand, some SEs have only a percentage of the business activities integrated directly into the social mission. Examples are ventures that run a normal profitable business and offers discounts to poor customers. Since not all of their business activities directly further the social mission, they are the same as mission-related SEs. When the sole aim of the business activity is to be profitable, then the social mission and business mission become mutually exclusive. The consumers of the business activity and the clients of the social program are entirely separate (see Figure 4).

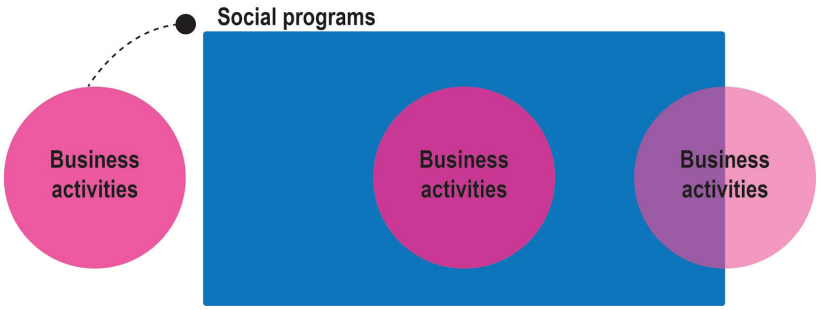

Fig. 4. *The different ways business activities associate with the social programs.*

Based on organizational structures

The social economy, or the "third sector," exists between the public and private economic sectors. This is the sphere of social economy that was dominated by the traditional NPOs, where now different forms of social enterprises also exist (see Figure 5). Currently the third sector has active socioeconomic engagement. The organizational structure of a social enterprise depends on the regulations in the country in which the social enterprise is established and also on the degree of the profit motivation of its business activities (discussed in the previous categorizations). Accordingly, it can be structured as a social business, cooperative, mutual organization, benefit corporation, charity, or NPO. ***Social business*** refers to the social enterprises of the embedded, mission-centric kind, which employs a sustainable strategy to support social programs. It is a non-loss, non-dividend company. Cooperatives are business organizations owned and operated by a group of individuals focusing on their mutual benefit.

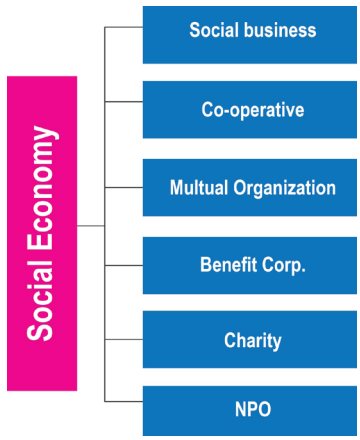

Fig. 5. *The various organizational forms that social enterprises tend to take.*

3.3 Regional Differences in Definition

Different governments as part of classifying the commercial activities also now define and differentiate social enterprises as a distinct category. The variations in perceptions, government definitions, and models social enterprises take in different geographic regions follow. Although mostly aligned, the main differences are in the regulations surrounding SEs.

- **US:** SE has long been aligned with philanthropy in the United States. While the gist of social entrepreneurial activities is "doing charity while doing trade," it is associated in the U.S. with "doing charity by doing trade" [1]. Businesses usually accomplish the latter by earmarking a certain amount of money in corporate social responsibility campaigns and donations. For a developed nation, the U.S. has a big chunk of population facing economic and social exclusion. Lately, social business initiatives have increasingly assumed the role of social empowerment of this section of American society where government programs have had little success. The main focus is on increased market engagement of marginalized communities with the aim of expanding their economic opportunities.
- **Europe:** In Europe, social enterprises are present mainly as community enterprises, which call for collective action of residents, government, and private and nonprofit entities to benefit a particular community through various means, such as income generation and education. The European Commission considers three types of businesses as social enterprises [7]:
    - Business based on a social objective of the common good as a commercial activity, usually in the form of social innovation
    - Business reinvesting profits in order to achieve this social objective
    - Business where the method of organization or ownership system reflects the enterprise's mission using participatory systems or focusing on social justice, for example

  However, there is no legal formality of a social enterprise. Most of these companies are therefore filed as nonprofit associations, such as social cooperatives or nonprofit organizations (voluntary organizations, charities, or foundations). Finnish law makes no distinction between social enterprises and other businesses. No special support is available for these companies in Finland.
- **UK:** Social enterprises in the United Kingdom are analogous with social sector organizations that comprise charities, community benefit companies, as well as societies. In comparison to the U.S., in the UK SEs are more cooperative and based in community organizing. The British government's definition of social

enterprises [8] is in line with the European Commission's. It is important to note here that companies registered as social sector organizations in the UK are regulated, meaning there are restrictions on how they use or distribute their profits as well as assets. They cannot pay out more than 50 percent of their profit or surplus to owners and shareholders, and they must comply with legal and regulatory issues. Also, it is stipulated that they must earn at least 50 percent of their revenue from trading alone, and not from funds and donations.

- **APAC:** In India, social sector organizations such as cooperative societies are a huge and growing presence. They exist mostly in agriculture and also as workers cooperatives. Amul, a milk and related products brand owned by a cooperative body based in Gujarat, India, is jointly owned by 3.6 million local milk producers. In Hong Kong, the Home Affairs Bureau admits to an absence of a universal definition of SE and considers SE to be a business that achieves specific social objectives such as discussed previously. Its expectations on a SE's profit reinvestment is aligned with that of the UK.

3.4 Wider Context of Social Enterprises

General trends in the social entrepreneurial spectrum are explored here to gain better insight to this field. Of interest are the point of view of social start-up funds, the true nature of a social enterprise leader, and the customer base best served by a social enterprise.

Perspective of Start-up Funds

The expectations of start-up funds on the characteristics of a budding SE contributes to the better understanding of this field. Most SE funds have a neutral view on the organizational form a SE takes, as long as its primary focus is on delivering social impact. From their point of view, a social enterprise can have a for-profit or nonprofit business model, a choice that must be made carefully and for the right reasons. The following considerations must be kept in mind when making this decision:

- Nonprofits can sell products and services (in most countries) just like for-profits, and for-profits can accept donations just like nonprofits.
- Business discipline and sustainability are not unique to for-profits. Nonprofits do not make profit, but ideally they should not operate at a loss either. Nonprofit revenue (earned income + donations), while it can be transient, is not entirely unreliable, as is the general perception. Religion-based organizations, for example, have sustained for many years entirely on donations.
- A for-profit model is not necessarily needed to ensure proper financial com-

pensation of employees. A nonprofit's operating budgets also account for employee salaries. However, chances are that the nonprofits have lower average salaries. In such cases it is understood that the salary deficit is compensated by the satisfaction of "doing good."

- Impact investing has a dual purpose of causing social or environmental improvement and also making profit. In emerging economies, impact investing supports microfinancing, sustainable agriculture, and clean technology. Financial support to big corporations like Apple and Tesla Motors in their efforts to reduce environmental degradation also counts as impact investing [9]. These funds are a big motivator for social businesses and are growing quickly: According to a recent JP Morgan survey [10], in 2013, $11 billion was invested across 4,900 deals, an increase of 250 percent in the last two years.

Psychology of a Social Entrepreneur

Like all entrepreneurs, social entrepreneurs are innovators. They focus on transformative innovation using new financial or digital technologies, new products or services, new operating or production methods, or new kinds of organizations through market-based approaches. Social entrepreneurs are thus agent of change; they solve the root problem through business. Commercial entrepreneurs, on the other hand, build a business model that can systematically give returns. There might be a social aspect to this business; however, it is still acceptable if the profit motive overshadows the social value, which is not the case for a social entrepreneur.

- Entrepreneurs are influenced by their society. Social entrepreneurs need to deeply understand the context and nuances of the issue they wish to influence. This learning process needs to be exhaustive and is abstract, compared to the practical approach of their commercial counterpart [11].
- SEs tend to be founded by people who would not otherwise be interested in starting a business. Nevertheless, these entrepreneurs are driven by a desire to societal change without huge profit margins.
- The SE spectrum attracts a lot of women entrepreneurs. The UK has seen an increase in women leading social enterprises in recent years [12].

Customers Served

Social enterprises can target a variety of markets. In general, the business models are designed so that the customers social businesses serve are also their clients. While many social businesses operate community enterprises, most of the attention in recent years has been on the low-income population, which makes up the

bottom of the world's economic pyramid. This section of the world population is referred to as the BoP - Bottom of the pyramid or Base of the pyramid. The BoP segment (tiers 4 and 5 in Figure 6) is in excess of 4 billion people, who live on less than $2 a day or less than $3,000 per year.

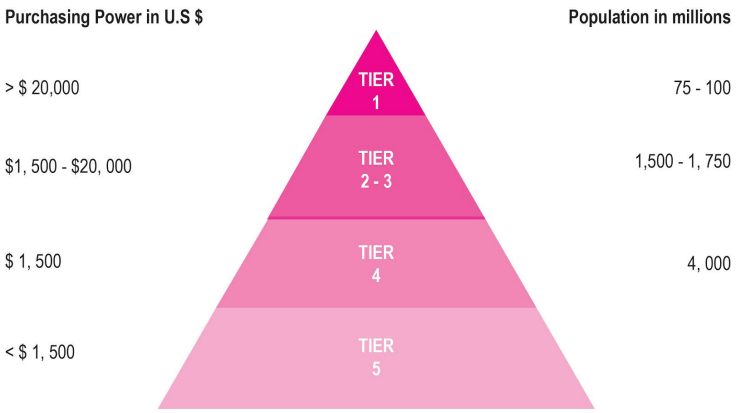

Fig. 6. *The world's economic pyramid. Source: U.N. World development reports.*

Tier 5, with annual purchasing power parity of less than $1,500 is considered to live below the poverty line (BPL). To empower the BPL population, initiatives of a humanitarian nature are most suitable. Nevertheless, the BoP still has a combined purchasing power of $5 trillion, which was brought to attention by C. K. Prahalad's seminal work *The Fortune at the Bottom of the Pyramid* [13]. A large number of immersive social enterprises focus on directly approaching and serving this segment of the world population. The BoP's growth potential contributes to the status of emerging economies, which are mainly the developing nations in Southeast Asia and Africa (see Figure 7).

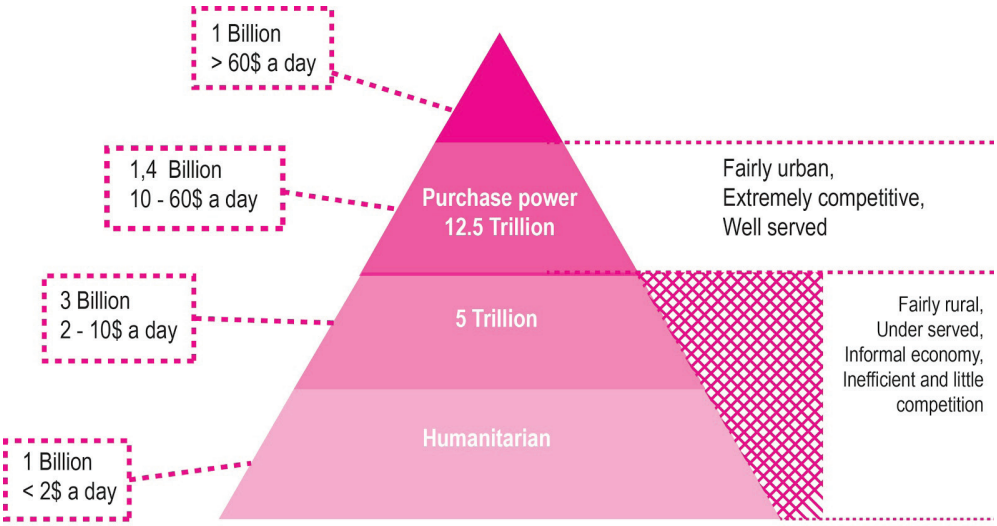

Fig. 7. *The purchasing power of the world's population.*

3.5 Summary

In summary, a social enterprise in principle can assume a for-profit or not-for-profit business model, whose primary purpose is social impact. However, for the purposes of this paper, we define social enterprises specifically as "social businesses," those social sector organizations that are mission centric and have their business activities completely integrated with their social activities. They usually engage in trading or selling. These social enterprises concentrate their operations in value creation and self-sustainability, requiring internal revenue from products. Their target benefit group and their customers are mostly the same, and they deliver their social value directly by carrying out business with them. Moreover, their business operates so that the profits earned serve to achieve a clear social mission and are reinvested for that purpose. Even when generally referring to SEs as for-profit institutions, their emphasis on the profit motive and the manner in which the business is conducted are key differentiators. Also, these social enterprises tend to be a hybrid of private, public, and voluntary sectors.

4 Exploring Social Enterprises: Case Studies and SE Matrix

This section discusses some well-known social enterprises and assesses their mode of operation.

4.1 Company Cases

Microfinance Enterprises

Microfinance is a kind of financial service for low-income individuals, unemployed people, and poor entrepreneurs to access services such as loans and insurance for protecting against risk, building assets, and stabilizing consumption. Microfinancing institutions (MFIs) help them improve their economic condition by lending small sums of money to start businesses and to mitigate unpredictable shocks and risks like natural disaster, illness, theft, and death. MFIs are active in developing countries where the gap between social classes is remarkable.

The financial products offered by MFIs—mainly microcredit, microsavings, and microinsurance—are aimed at the BoP population who have irregular incomes and unstable life situations. In spite of poverty, this segment of the population makes an effort to save money and make payments. Thus, the repayment rates of microloans are higher than the average in the commercial banking system. In 2016, the MFI Opportunity International reported repayment rates of approximately 99 percent [14]. Commercial banks manage risk differently than MFIs and as such, the high risks involved in lending to low-income households discourage commercial banks from extending loans to them. MFIs primarily act as lenders and may also coach borrowers in their small business ventures and even provide performance incentives.

The scale of institution activities depends on the customer size, from small nonprofit MFIs to international banks like Citigroup that have entered the microfinance business. It is possible to divide MFIs into for-profit (like Grameen Bank) and nonprofit institutions (such as Kiva, Microloan Foundation, and Unitus). The rate of interest usually differs depending on the type of microfinance; the default rate is usually less than 10 percent.

As a general rule, for-profit microfinance organizations tend to maximize returns for their investments in comparison with nonprofit microfinance organizations. MFIs operating for profit have come under criticism for their high interest rates. Short loan repayment times (6–12 months) at 30 percent interest rates (much higher than standard banking rates) go against the purpose of mi-

crofinancing—to enable the poor, which in turn mitigates poverty. On the other hand, founders of for-profit microfinance institutions believe that high interest rates impact the number of customers, so that they can lend much more money to a broader scale of borrowers. To illustrate, Grameen Bank operates at different interest rates, from a 20 percent interest rate for income-generating loans to interest-free loans for struggling members [15].

Grameen Bank

Grameen Bank was founded as an independent bank in 1983 in Bangladesh by Professor Muhammad Yunus (University of Chittagong). The two main activities of Grameen Bank are microfinance and community developments. "Loans are better than charity to interrupt poverty" it is a founding principle of the Grameen Bank, which is based on the idea that the poor have skills but have no chance to use their abilities without some money. Therefore, the bank offers small loans (microcredit) to the poor without requiring any money or collateral.

Grameen Bank's solidarity lending incorporates a set of values by the "sixteen decisions." The borrowers need to learn and recite these decisions and vow to follow them. Each borrower must belong to a five-member team. The team does not need to give a guarantee for a loan. The loan is made to only one person, but the whole team guarantees that the money is repaid. Each member has to pay for their loan, but if they have problems, the group may help them to pay. The group would not get any further loans from Grameen Bank if all the group's loans have not been repaid. Currently, Grameen Bank has more than 24 enterprises under the Grameen Family of Enterprises, including Grameen Phone, Grameen Business Development, Grameen Communications, and others in telecom, education, and small industries.

Kiva

Kiva is a global nonprofit microfinance enterprise founded in the U.S. in 2005. Kiva's microlending happens through crowdfunding or peer-to-peer lending. As of 2016, it has more than 1.5 million lenders and 2 million borrowers and is widely active in Asia, Africa, and South America. Kiva is a good example of social enterprise that is working globally with MFI partners from different countries to act as bridge between borrowers and lenders. These partners screen borrowers, post loan requests, disburse the funding, and collect repayment. Kiva provides interest-free loans for supporting a range of activities: female-owned business, green activities, and higher education. Although Kiva as a nonprofit enterprise claims a 0 percent interest rate for returning money, its partners have different

rates of interest. For instance, the interest rate of its partners in central Asia is ranges from 20 to 84 percent (Figure 8).

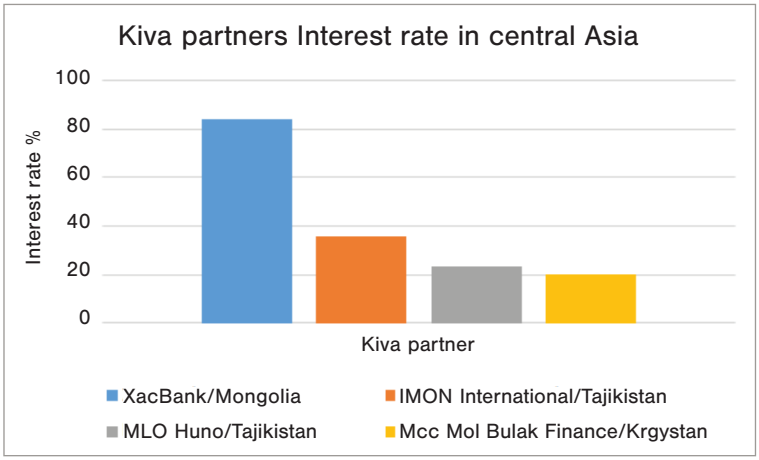

Fig. 8. *The interest rates levied by partners of Kiva in central Asia [16].*

Fuzu

Founded in 2006, Fuzu is an online career and recruitment platform based in Finland and operating currently in Kenya. Defending the decision to establish Fuzu in Africa, CEO Jussi Hinkkanen points to the "dead aid" in Africa where the project-centric approach of big aid organizations like UNICEF slows operations. The resource mobilization and work delegation is too sluggish to see a worthwhile impact. Local national governments in Africa too have been incapable or inefficient in carrying out public benefit policies. Private sector players, on the other hand, have a higher pace and are more practical.

Hinkkanen, however, does not define Fuzu as a social enterprise, as its business portfolio is not strictly socially motivated. Fuzu is a profit-motivated business that targets the huge untapped pool of users seeking career guidance and employment opportunities in Africa. The social transformation Fuzu engenders occurs tangentially to its primary motive of profit creation. Fuzu's objective is to cater to the middle of the economic pyramid with hopes to benefit the BoP in the process. The reasoning to create such a business model instead of that of a typical SE is that having a profit base allows Fuzu to attract competent employees with skills who produce faster results. By building the company to be more sustainable and profitable, it becomes a leaner and meaner way of operating, compared to that of a nonprofit organization.

VisionSpring

Founded in 2001, VisionSpring makes and distributes readymade eyeglasses at affordable prices to the poorer population in developing countries. It operates mainly in India and South America. It delivers a pair of glasses at $6, in comparison to recycling programs that cost three times as much to reach recipients [17].While some of these donated eyewear end up helping people in need, these programs do not address the human preoccupation with looking good and by extension, the right of choice. For example, a woman in rural Colombia, in spite of being nearly blind, returned a pair of donated glasses that marginally improved her vision because she was being ridiculed in her village for how they looked.

VisionSpring restores this right of choice to its consumer base by offering a range of eyeglasses in different styles. The enterprise determined that the BoP population is willing to spend up to 10 percent of their monthly income for a corrective pair of spectacles. These are people who have suffered from impaired vision their entire lives and are daily wage earners, including laborers, artisans, and carpenters. The difference corrective eyewear makes in their day-to-day life is immense; improved vision can boost the annual earning potential of one of its consumers by $108 [17]. VisionSpring employs a high volume–low margin approach to serve the BoP, whose sheer numbers make this group a viable market. As per the latest available audit from 2014 published on its website, VisionSpring received $3.5 million altogether in restricted and unrestricted donations and had a total income of $1.6 million [17].

4.1 Measurement of SE: Creation of the SE Matrix

A company without a social cause as its main objective can also contribute to society by donation, creating charitable institutions, sponsorship, and welfare programs. Private corporations that have as their main objective making profits and not social causes are not SE, although some companies are able to maintain a balance between owners' benefits and a social cause. We've mapped out attributes of various companies to understand their dynamics and to assess which qualify as social enterprises. The companies analyzed in our matrix correspond to the cases previously discussed. All the parameters used are qualitative in nature, as we lacked empirical and statistical data to carry out a deeper analysis. Chief among the parameters are revenue, social value, scalability, nature of ownership, and government regulations.

Money: While this is an important aspect for all enterprises, the nature of revenue streams and the quantity of profits paid out are all important delineators

for a social enterprise. The more important aspects are financial sustainability, reliable revenue stream, and restricted accumulation of wealth for owners. We mapped the enterprises in the matrix on the basis of the following questions. Do SEs:

1. Have paid employees or volunteers?
2. Have a revenue stream, either income or donations?
3. Have financial sustainability?
4. Have wealth accumulation restrictions on founders?

Social value: The objective is to ascertain how social value is delivered. The main learning will be to understand how the societal change has been carried out and through which means. Social wealth can be created in terms of improving the well-being of individuals and communities, restoring human dignity, providing better education, increasing social inclusion of vulnerable groups, delivering economic empowerment, and conserving the environment. The enterprises in the matrix are mapped on the basis of the following questions:

1. Do they aim to alleviate major social problems (e.g., equality, accessibility, exclusion)?
2. Does the enterprise propose innovative schemes or methods (e.g., symbiotic, participative, crowd-sourced)?
3. Does it challenge monopolies built by the public and private sector in the process?
4. Does it restore human dignity in general and/or absorb and abolish risk for the people it serves?

Scalability (replicability): The understanding is that size of a social enterprise does not matter as long as it delivers a tangible social impact. But the question is if the impact is measured in terms of the number of people influenced or the extent to which the lives of a certain small population was improved. An assessment of the qualitative or quantitative social impact provides a lens to determine the scaling strategy of a social enterprise. The key competitive advantage can also be drawn out from this, which in turn influences the replicability of the business model. The parameters assessed include:

1. Clear problem definition
2. Vision and mission that allow the organization to focus on social issues
3. An impact goal: the who, what, how, and where of the social impact
4. Collaborative vs. competitive approach
5. Clear goal of what the organization should be in the future
6. Core concept, that which will need to be replicated

These parameters are discussed in section 5, which outlines factors that promote or prevent SEs to scale and replicate.

Nature of ownership: This criteria determines if the business activity happens simultaneously with the social mission, or if it happens outside it, as with NPOs that have mission-unrelated activities. While the latter is admissible as a social enterprise, this criteria only serves to determine if the social firm has its origins in social intrapreneurship. If the social business was intrapreneurial, meaning it originated inside another organization, then it is inadmissible as a social enterprise. The questions raised to qualify an enterprise are:

1. Is it a social enterprise from its inception, or is it an NPO with commercial activity?
2. Is it a social intrapreneurship within a private for-profit company?

Government regulations: Many national governments regulate the profits earned by firms registered as social enterprises. The enterprises may even get tax rebates and subsidies and also have access to various government-aided funding channels. In some cases, these are dependent on the size of the enterprise; SMEs (small or medium-sized enterprises) tend to get more attention in the UK, for example. This criteria serves to understand if the government where the social enterprise is established identifies it as a social enterprise.

Table 1. *The social enterprise matrix.*

Parameters	Companies									
	Aarong	Vision Spring	Grameen Bank	Fuzu	Impact Water.co	Red Cross	Caritas	Startup-health	Tesla	Gravity light
Social inclusion	X						X			X
Scalability		X	X		X				X	
Alleviates social problems	X				X	X	X	X		X
SE from inception		X			X		X			X
Has employees	X		X	X		X	X	X	X	X
Has volunteers						X	X			X
Has income and donations	X	X	X	X	X	X	X	X	X	X
Financially sustainable	X	X	X	X	X	X		X	X	
Restricted wealth accumulation		X	X		X	X	X			
Innovation		X	X	X				X	X	
Restores human dignity	X	X	X			X	X			X
Challenges status quo		X	X				X		X	X
Abolishes risk			X		X		X	Partly		
Competitiveness	X	X	X	X		X		X	X	
Possibility of growth	X			X	X	Global	Global	X	X	X
Social arm of a big corp	X			No	No	No	No		No	No
Government regulated				No						

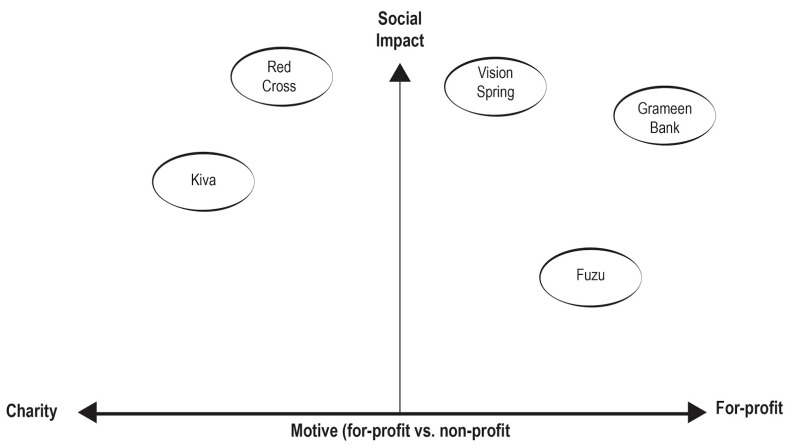

Fig. 9. *The distribution of the analyzed companies in the social impact vs. profit spectrum*

5 Steps Towards Being Born Global

A born-global firm is described as one that from its inception contrives to operate in a foreign market and to do business and be active in multiple countries. The nature of SEs bind them to different criteria and methods for becoming global. The clearest path for SEs to become globally operational enterprises is through the implementation of tools for social awareness and the fostering of ethical practices, which will determine how replicable their models are and how far and wide their footprint will be. The literature on the topic is clear on enumerating the challenges that SEs face to create positive impact in society and/or ignite social change, such as financial sustainability. Whatever the challenges may be, the growing number of global SEs starts to draw a pattern of success that has also been reviewed by experts in the field.

An SE's subsistence is financed by trade as well as donations, which makes scaling difficult to measure, as opposed to the growth measurement of a for-profit enterprise. The scaling of a SE might be referred to as "social replication," as the act of taking the organization or its core principle to other geographic areas and starting a "new cell." According to the International Centre for Social Franchising [18], there are three ways in which an SE may replicate—by *affiliation* or *dissemination,* or as a w*holly owned entity*—along with a set of key factors that will be discussed in detail in the following sections.

5.1 Key Factors for SE Scaling

The scaling of a company refers to an expanding volume of its operations, performance, or workload. The impact of a social enterprise needs to be assessed in terms of the number of people it affects, the depth of transformation, and the amount of social value delivered. To expand to other regional or global markets, an SE would need to have:

1. **Good cash flow.** This would be ensured by a sustainable business model, where there is evidence that the cash flow is consistent and the organization is stable and financially healthy.
2. **Solid mission.** An SE's mission statement defines its current social entrepreneurship activities, and all its interactions in an environment of customers, employees, and founders. An SE also needs a clear vision of how it will impact the world and create new alternatives in the same way its leaders should foresee its future 20 years down the line. Leadership, moral responsibility, innovation, partnership, and purity would be the key values on which to build an SE's future. Such a road map makes for a real criterion to measure the level of achievement and to compare strategic objectives.

3. **Focus on scalable solutions.** This means a clear core concept that is replicable and adaptable to variable contexts, a concept that coexists with other institutions in the same ecosystem. The core of the company can be: (a) the organization itself (the way you deploy resources and mobilize people); (b) a program (working strategies to achieve certain goals or impact); and/or (c) principles and approach (guidelines and best practices to achieve the goals) [18]. Also needed is a "theory of change," clarity and knowledge on circumstances where the SE can make an impact, the assumptions made during the process, and the evidence supporting project execution.
4. **Impact goal.** The SE's intended impact has to be quantified in terms of who, how and where. Impact goal implies a clear understanding of the type of social change the SE carries out—locally and eventually globally—and strategic planning to better decide where to allocate human and capital resources.
5. **Proof of impact.** For an SE to replicate, it needs to provide a coherent chain of evidence of its impact and/or effectiveness of its solutions, programs, or strategies. In other words, it should be able to demonstrate that the expected change has indeed taken place and that it is a consequence of its programs. Additional evidence that the same change can occur elsewhere is also needed. A solid proof of impact influences cash flow, investors, or contributions. It would also determine if the SE should be conservative and limit itself to the original market or expand.
6. **Ambassadors.** In many situations, an SE relies on advocates or ambassadors to break ground for replication in a new location. These are the people with the knowhow and capability to oversee implementation of policies, regulations, programs, and guidelines of principles.
7. **Proper market study.** An SE needs assurance that new geographical locations are indeed conducive for replications. This requires cultural awareness, which is essential for social impact projects to thrive in a new location. If the core of both the problem and solution are clear, then replicating a model is almost a tailored project where the essence of the solution is still palpable.
8. **One market at a time.** Before replication, the SE need to be a strongly positioned brand in its original location; trust and recognition of the society are essential. This will determine future funding, contributions, partners, etc.
9. **Collaborators.** One of the most important issues in an SE's replication is to determine who would be interested or capable of running the venture in the new location, once the ambassador has introduced the model. Some SEs fail to question if they may have the specific personnel or sister organizations that could cope and customize according to local needs.

When replicating, an SE can take any of the three following routes based on

the degree of legal control the original organization has over its replicas [18]. The most flexible and easy way (with the least amount of control) to replicate to a new location is through **dissemination:** to enable an independent actor to implement the venture by providing information and advice. In this case, the SE (originator) can charge a fee to the implementer, but it is not bound by any ongoing legal or financial ties. In some cases, dissemination may only involve tools, methods of implementation or curriculum that are quick and easy to adopt. On one hand, some of the advantages of the dissemination model are that it poses fewer barriers for implementers. It requires less monitoring and may give way to innovative and creative ways for implementation. On the other hand, the same advantages can be perceived as potential disadvantages since the dissemination model is also perceived as "loose" and therefore cannot guarantee best results if the implementation of a model is not thoroughly supervised by the originator.

A midpoint would be the affiliation model where an official relationship between the two parties exists—the original SE and the implementer. The terms between the organizations are defined through appropriate legal and financial framework, which involve fees. This model is appropriate where there needs to be a closer relationship between originator and implementer to ensure success. The advantages of affiliating are the sharing of financial burdens, access to local resources, new knowledge building, quick understanding of new markets by working with locals, and increasing visibility of the brand. The disadvantages are that affiliated organizations are independent partners, which means that they are in control of their operations and quality controls, and any change needs to be negotiated. A good example is how Kiva operates through its local field partners in different countries.

Finally, the other end of the spectrum is wholly owned, where the originator has its own employees in established regional offices to carry out direct implementation of the social ventures. This affords complete control of the process and ensures a good standard of services; it is the most attractive to investors as it is the most reliable and least risky, decisions are taken centrally without broader negotiations, and it ensures a consistency in management. Disadvantages of this model are the same as in any growing enterprise—that is, bureaucracy, sense of ownership, inflexibility, difficulty to adapt, and slower replication, among others.

The complexities and interdependencies of the SE scaling process are demonstrated in the development of a framework by Weber, Arne, and Kathrin [19]. We draw on the similarities between this study and the key points for being born global previously discussed. In this framework the key growth components are referred to as greater "areas of action," and the main drivers for social replication include the individual itself, management competencies (sustainable business model), and replication options, from entire to partial or as affiliation, dissemina-

tion, and wholly owned. It refers to an SE's ability to meet social demands as its capacity to achieve impact goals and proof of impact. This framework equates the ability to obtain resources as the network of support from where money is drawn, similar to market study and conquest, potential effectiveness of scaling social impact with having collaborators, and adaptability as the diversity of activities depending on each location's social context (market study and cultural awareness). This theoretical model refers to scaling strategies as different subcategories, broken down as per the theory into (a) capacity building, (b) relationship defined by an ongoing agreement, and (c) diffusion of knowledge, which we identify as the activities ambassadors carry out when replicating an SE somewhere else, from the ICSF toolkit for social franchising [18].

Finally Weber and colleagues [19] discuss the "critical decision-making path" as a series of stages to assess the scaling plausibility of an SE, a step-by-step manner to determine when and how an SE may scale or should abandon the idea.

5.2 The A. T. Kearney's Social Enterprise Accelerator Model

The accelerator model [32] was developed by collecting information from small to large social enterprises in different sectors and inside knowledge provided by the people running them. It groups the key growth factors differently from the previous toolkit. It compiles them into comprehensive layers that integrate different factors. The models reviewed in this sections are similar in what they consider the key elements for SE scaling capabilities to be. They differ only on their categorization.

- **Foundational factors (Layer 1):** includes the basic elements that any SE must have to get off the ground, like clear mission and vision. These statements need to succinctly convey who the organization is and what it stands for. It summarizes exceptional leadership, which is a difficult soft skill to describe, as that which possesses "business skills, a passion for a cause, and the ability to navigate and innovate in an emerging space," making a strong emphasis on the role of the individual as a growth catalyst for the SE. One of the most important elements discussed is the core product or service, which is key for an SE with global ambitions. A well-defined product and service will yield the same benefits and betterment in different places regardless of cultural differences. The implication is not "one solution fits all" but that the main issues requiring attention (poverty, violence, health) can be positively affected through the aforementioned factors. The last factor included is funding, where the discussion does not differ from other authors. Healthy and sustainable financial models are needed for growth.

- **Growth levers (Layer 2)** are those that scaffold an SE toward growth. Levers are referred to as digital technology made available and used to maximize operations that help SEs grow and have a global presence. The diversity of innovative options offered can help an SE disrupt markets and societies and take leaps into new ways of working, operating, connecting, and socializing. Cost-effective platforms are an example of the type of tools made available for greater-out reach as delivery, product development, demand generation, prototyping, sharing, and support. Such platforms enhance productivity and fosters shared knowledge as a crucial factor for growth, offering the possibility to the SE to allocate knowledge to its members—who eventually may mentor, affiliate, and franchise as a capacity building strategy. The more knowledge shared across the organization, the easier it is to "build the social enterprise ecosystem" enabling growth.
- **Market makers (Layer 3)** refers to the "attitudes and behaviors necessary for a social enterprise to become a true force." These refer to the perception investors may have of an SE and, sometimes, their lack of understanding of its role in the market. Lack of understanding of what market gap an SE fills and its potential benefits are the main cause for low investments which undermine the SE's capabilities to influence policy making. The SE's work not only focuses on societal betterment but also on how to shape markets to it benefit. A social enterprise needs to leverage its potential influence in higher spheres of society, such as raising one's political profile to attract investors.

In conclusion, A. T. Kearney's Social Enterprise Accelerator Model does not offer any new perspectives on the path to growth for SEs but does offer a different categorization of tools and attitudes. The mind map in Figure 10 depicts the two models described in this section.

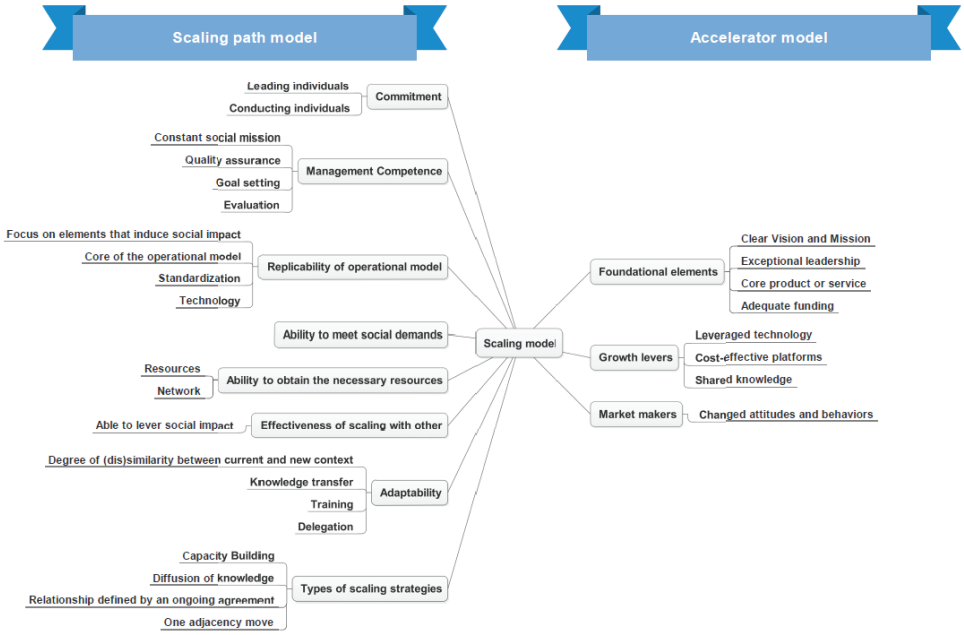

Fig.10. Mind-map *depicting the aspects of SE scaling as seen from the theoretical scaling model by Weber et al. (left) to A. T. Kearney's Social Enterprise Accelerator Model (right).*

5.3 Globalized Business Models

With the advent of digitalization, businesses have been increasingly spreading to access foreign markets and to get established solely aiming for such markets. Among these are many social organizations like charities that work sometimes exclusively in nonnative countries. A social business that from inception aims to debut in a foreign market and expand to many more can be fairly referred to as being "born global." Grameen Bank is an example of a social business model that was established and operated locally in Bangladesh but then expanded to being present in many countries. Kiva, on the other hand, was founded in the U.S. but catered to third-world markets from the beginning. Both these institutions have multinational footprints and are thus globalized in that sense. Nowadays, technological and financial enablers encourage many novel social business ideas to be born global. Nevertheless, for an SE with a high impact vision, going global can be vital equally to business sustainability and to mission fulfillment. Toward this end, many different practical strategies can be adopted.

Collaboration: Driven by their shared interest to engender positive social impact, different SEs can collaborate or create alliances to maximize their outreach.

This can happen through sharing their infrastructure and/or customer base. When not all partners in the ecosystem are equal, their products and services or mission statement will vary accordingly among the partners.

Several SEs leveraging the shared ecosystem in Southeast Asia came to the fore at the 2016 ASEAN Conference on Social Entrepreneurship. Some examples include "Agrigator," an online platform that provides information on food producers in Southeast Asia to help connect buyers and investors. "TripAbility" is another SE providing information on accessible tourism destinations and facilities that are disabled-friendly [20]. The business models of these SEs prove that maintaining an open and transparent relationship with many stakeholders, partners, alliances, and governments improves their opportunities for success.

Global problems: The world is interconnected more than ever, and the urgency of global problems is all the more evident. With shared information has come the realization that we have similar goals impeded by variations of the same problems, which necessitates immediate action. Alleviating poverty and environmental degradation are aims of SEs operating in different parts of the world. The diverse knowledge, perspectives, skills, and experience of these social ventures when combined can be a powerful tool. An SE aiming to be truly born global should leverage on this shared wisdom and directly address a global issue. The sustainability goals of the United Nations, summarized in Figure 11, focus on many of those issues.

Fig. 11. *UN's sustainability goals as of 2015.*

ImpactAssets is an example of a new kind of financial services firm that earns fees from managing donor-advised funds and other investment products. It also

receives grant support, largely to help with its advocacy work for the field of impact investing. Its goal is to scale up and "democratize" impact investing by addressing the systemic challenges of poverty, income inequality, and climate change [21].

Innovation: When dealing with the BoP, the opportunity of innovation or technological advancements is often neglected. The reason is the wrong assumption that the pyramidal base may not be well adapted to emerging technologies due to their limited means. However with proper education and knowledge channels, technology helps SEs devise innovative methods to deliver value to this section of society. These business models also tend to be easily replicable and thus aid SEs to expand their services faster.

One interesting case study of implementing innovation is the mobile banking service call M-PESA ("mobile money" in Swahili), launched in 2007 in Kenya. This microfinancing service that allows anyone with a passport or national ID to transfer, withdraw, or deposit money or pay for goods and services. Users don't need any kind of bank account; they simply need their mobile phones and then funds can easily be moved via SMS [22]. This service has been tremendous for small businesses in Africa, especially Kenya [23]. It has now expanded to India, Afghanistan, and Romania as well.

Start-up culture: SEs with a strong local presence and sizable operations should mentor and share knowhow and customer base with inborn start-ups that share the same vision. From the parent SE's perspective, the best way to enhance revenue streams is to maintain separate personnel and to ensure that the spinoffs' business model is based on the parent SE's work. This way, even when the spinoffs are thought of as independent enterprises, they retain strong links to the parent organization; higher management could even be the same in both. This may allow possible partnerships or collaborations and help the parent SE as well its spinoffs to expand their services.

An example is the case of *The Big Issue*, the world's most widely circulated street newspaper [24] and Women's Subscription Enterprise (WSE). *The Big Issue* exists as a not-for-profit social enterprise; the paper is written by journalists and circulated by homeless people. WSE spun off as a fortnightly magazine from *The Big Issue* in 2010 and employs marginalized women [25] in Australia in packaging. The magazine's revenue comes in the form of subscriptions and donor funds, which are maintained separately. Currently WSE is expanding to more cities. Thus through a different product and target demographic, the spinoff helps the parent SE to expand its outreach [26].

Demonstrated impact: Storytelling should be at the heart of any social enterprise. This and transparency are key to an SE in creating a great community. This is achieved by giving supporters direct insight into your cause, solution, and cases, not just numbers about total dollars being given to the cause. One medium for storytelling is a landing page dedicated to an SE's cause, goals, and tangible impact. Showing the total impact of its efforts on a personal level through photos, narratives, and in-depth views of its workings reinforces the confidence that customers and contributors have on the enterprise. It bodes well in attracting new donors, advocates, and future collaborators who help in furthering the cause. For example, UChic's impact marketing strategy highlights the stories of the young girls it supports through scholarships by giving a face to those the customers are helping through product purchases [27].

Ties with NGOs and charities: SEs should actively seek financial support from government subsidies, charitable foundations, and a handful of high-net-worth individuals who will donate and or accept lower financial returns on their investments in social projects. Donations are vital to bridge the gap between costs and revenue. Nevertheless, fundraising efforts consume time and energy that could be spent on their social missions.

However, by networking with NGOs with a common mission, SEs gain a lot. NGOs can provide expert advice on impact measurement and engagement with the community in general and with politically and financially marginalized people in particular. They can also help with supply chains, producers, and consumers. For example, Filipino NGO Gawad Kalinga provides an incubation space for social enterprises in the communities it serves [28].

Montenegro's SE landscape is another such example where majority of SEs work to employ and ensure socioeconomic inclusion of disabled, women victims of violence and elderly women, and members of the Roma and Egyptian population. Revenues from sale of services and goods are insufficient to pay their employees' salaries. The deficit is met through grants [29].

Online presence: A social enterprise in online retail business has a big advantage. An example would be a company selling ethically made clothes and bags. Data traffic analysis of the e-commerce on the website helps to assess the regions where the SE generates the most interest. Digitalization makes the foray into new markets easy, with necessary customization of the product repertoire. With this expansion, the social vision gets better exposure.

A study on the impact of Internet and digitalization on small and medium-sized enterprises (SMEs) in India by KPMG India and Google [30] revealed that rising

internet penetration and greater uptake for digital by SMEs could help increase their contribution to India's GDP by 10 percentage points, taking it up to 46 to 48 percent by 2020. Digital SMEs can grow profits up to twice as fast and employ up to five times more employees as their offline counterparts. Nearly 51 percent of digitally enabled SMEs cater to customers beyond city boundaries as compared to 29 percent of offline SMEs. With such predictions, the SMEs and SEs should think of investing their part of limited resources on digital infrastructure to increase their outreach and impact. This Indian model can be replicated to other South Asian and African countries as they share the same problems and issues.

Bricolage: *Bricolage* is defined as the process of applying combinations of preexisting resources to create new outcomes. It is a way of mobilizing resources in the general absence or lack of institutional, technological, or business support for SEs. For any venture, the distinct resources are material, labor, and skills. The constraints that necessitate bricolage are visible as political, regulatory, or ease to do business.

The political climate and policy making (institutional support) in a country affect an SE's choice of bricolage. SEs that operate for causes and opinions that are at loggerheads with local governments fail to gain legitimacy and face hindrances in accessing resources and support from grants. One study [31] finds that the level of political instability in an SE's founding country adversely affects its initial resource mobilization. Another constraint is technology regulation, mainly for technology social ventures. The global competitiveness technology index indicates the role played by technology in different countries at various stages of technological development. Developed nations push toward tech innovation, while developing countries move toward adopting existing technology from their developed counterparts. Moreover, social ventures whose cause matches the level of technology strength or aspirations of their operating location are likely to get access to materials and employees of suitable skill level [31]. When they don't match, skill acquisition is difficult, and the enterprise has to use the existing talent pool and come up with new ways to train employees and volunteers. An example is the Landmine Detector from Benetech deployed in Southeast Asia. It employed military technology to detect mines and explosives but found a mismatch between the knowledge level of local deminers and the commercial providers of this advanced technology. To overcome this gap, Benetech employed a successful bricolage approach to create an advisory team of professionals for educating about the advantages of the particular technology.

Ease of doing business refers to the ease with which a venture can be established, operated, and closed in a particular country. This factor, which is ranked

in *World Business Rankings,* is particularly important for new ventures. In terms of resources, it was found that bricolage becomes a necessity when the formal cost of doing business runs high [31]. In locations that rank high on the index of ease of business, bricolage may not be necessary. However, in low ranking locations, SEs may need to rely on material, skills, and labor bricolage.

International social enterprises often face severe challenges when addressing problems hitherto unaddressed or unrecognized. Innovative resource utilization through alternative, informal methods can bridge the gap between the venture's needs and what its environment can offer. The cascading effect that bricolage creates may be slow but is positively transformational to the institutional and business environment. It is a process and mode of change.

6 Discussion and Conclusions

If an SE from its inception is aiming for a wide footprint and a widespread social impact, it should address the ways in which it can be born global. This has to be incorporated into its mission and future roadmap. The decision to operate in a foreign market is not a simple decision for an SE to make, as the peculiarities of its operation model and target consumers and the uniqueness of its service all have a say in this. In most countries SEs have to deal with the fact that regulatory, infrastructural, business systems are still in a nascent stage. To go global, SEs have to customize their value chain while discovering new ways to reach out to varied markets. Wherever they cannot standardize in their business model, SEs have to adapt by entering informal, nontransactional partnerships with local bodies. When working with the BoP, adopting market-based approaches that leverage technological advancements hold a huge potential.

The initial capital available limits an SE's initial scope of activities and its physical presence in target markets. In regions with countries with similar jurisdiction like Southeast Asia and Latin America, it may not be difficult to start operations simultaneously. This would be further easier for enterprises whose operational model involves a strong online presence. For enterprises involved in immersive work with their clients, it would be better to be pragmatic, start small, and then expand as they seem fit. The best bet for a new SE will be to start local and then systematically replicate in order to scale. Also, registering local operations is subject to governmental regulations. This could be an impediment in nations with unstable political situations. In the end, the decision of scaling and going global depends on the extent of impact to be achieved. Nevertheless, for the success of an SE, it has to be ensured that its clients are being empowered by the business it does.

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Entrepreneurship and the Good Life: An Autoethnographical Study of the Question, "Why Not Be an Entrepreneur?"

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ABSTRACT. *In our everyday lives, we encounter what the philosopher and sociologist Roberto Unger calls "the flaws of being human." These unchangeable elements of human life create internal conflicts as we progress from childhood to the grave. While social and institutional structures have risen to calm our fears or distract us from the reality of our irreparable faults—mortality, groundlessness, and insatiability—these self-same structures cannot bring contentment and peace in a world of constant change. However, Unger goes on to suggest a future in which, collectively and individually, we can face our flaws and live a good life. The question that motivated our study was, "Why not become an entrepreneur?" In searching for the answer, we examined our own pasts, presents, and futures. There are no simple answers. We will first describe Unger's immutable flaws of human nature, with the addition of one variable weakness that can be mitigated. Second, we will present our own reflections on how we came to Finland, what we are doing today, and what we think tomorrow will bring, as these all shed light on the discourse around entrepreneurship. Finally, we will demonstrate through our own analysis that the question about becoming an entrepreneur requires reflection on much deeper questions related to living a good life. The motivation to study this topic arose from several discussions with business and academic professionals in the United States and Finland. Specifically, we felt that there is a dominant narrative that we should become entrepreneurs. Rather than studying this narrative, we discuss our responses to our perception of it and how those may be reactions to what Unger refers to as "our fatal flaws."*

KEYWORDS: *entrepreneurship, philosophy, Unger, autoethnography, identity, opportunity*

1 Objectives of the Paper

To a frame of philosophy and social science presented by Harvard professor Roberto Unger, we will compare our own thoughts on what our behaviour and practices have been, are, and perhaps will be. This structure of past, present, and future encompasses why we decided to come to Finland, what we do now, and what would need to happen for us to consider self-employment and/or entrepreneurship. The reason we chose this path is rooted in a strong desire to personalize and contextualize many of the discussions we have been having in recent months. Ultimately, each of us, looking at our own reflection in the mirror, ask, "Why would I become an entrepreneur?" Our answers to this question may shed light on some of the discourse around entrepreneurship.

2 Introduction

One goal of this paper is to explore entrepreneurship from a subjective point of view. Using the work of the noted Harvard philosopher and Brazilian politician Roberto Unger, combined with reflective approaches to entrepreneurship, we question why we would consider entrepreneurship as a career path. The debates within the academic field of entrepreneurship may focus on starting new firms [1], corporate entrepreneurship [2] [3], opportunities [4] [5], identities [6] [7], emotions such as fear [8], social responsibility [9], and many more. However, there is also a small group of scholars questioning whether entrepreneurship is classified properly—as that subset of business related to establishing new firms, new markets, or new products and services within existing firms and markets. "What if we have been thinking about entrepreneurship the wrong way?" ask Sarasvathy and Venkataraman [10]. This is both troubling and liberating. Troubling because it suggests that we have mistakenly pursued entrepreneurship in a narrow, focused manner and perhaps left out some of its richness and possible impact. Liberating because we can explore the richness and possible impact that a wider, deeper understanding of entrepreneurship could potentially have on our societies. Why we may have limited ourselves in the study of entrepreneurship could be the outcome of our social and political economies—the way we were raised, educated, and prepared for working life—the "should do/should be" of our cultures, languages, and interpretations of the existing world around us, our socially constructed reality [11].

We use a model that proposes the existence of human weaknesses and responses to them. Then we compare the model to our own reflections around

migration, employment, and the future. Further, we reflect on the themes arising from our analysis and how these can be placed within a discourse on entrepreneurship. Finally, we propose that entrepreneurship studies, and efforts to encourage students to become entrepreneurs, could encompass the aggregate themes and meta-theme that we arrived at through this process. A guest lecturer once asked us in class, "Why not become an entrepreneur?" This simple question does not have a simple answer.

2.1 Entrepreneurship and Philosophy

Unger [12] outlines three flaws within human beings that cannot be corrected, and a fourth that can: mortality, groundlessness, insatiability, and the corrigible flaw called belittlement. Everyone, he posits, has these flaws, and much of our lives are ordered and structured to mitigate or distract us from them. Unger goes on to explain how it is that we have attempted to deal with these flaws and, as such, how that has influenced our social institutions and political economy. "By the structure of society, I mean the institutional and ideological presuppositions that shape the routine practices, conflicts, and transactions in that society, and that are largely taken for granted, even to the point of being invisible, as if they were part of the nature of things" [13]. Looking at what we do every day, how we do it, why we do it, and for/with/to whom we do whatever it is we are doing reveals the presuppositions.

Mortality or death is quite obviously a shared experience of all living things on our planet. Although science fiction has found ways for us to live forever—at least in books and movies—the reality is that the current average life expectancy for men and women ranges from 50 years in Sierra Leone to 84 years in Japan [14]. There are many who live to 100, and many who die before reaching the age of adulthood. Nonetheless, we live knowing we are going to die, and in many societies and cultures, we simply do not talk about it.

Groundlessness is a bit less tangible than death. The idea arises from our place in the world and, in a sense, in the universe. As children, we wake up one day and begin to suspect that we are not the center of the universe. As we grow toward adulthood, we realize that not only are we are not relevant to the grand story of the universe, but we also have very little effect on this story. Many attempt to find ways to be rooted, to make an impact on society and the world, to contribute, and to avoid admitting that it is all quite small in relation to the universe. We point this out with full knowledge of the risk that others would call us defeatist, nihilists, or worse—just plain boring.

Insatiability speaks to the desire for infinity in a finite world. More than 50

years ago, Mick Jagger sang, "I can't get no satisfaction!" [15], and this cry continues to reverberate. We live in a finite world but want infinity. We improve our health, our education, our social standing, and yet we are almost constantly considering what to do next, where to go, how to get a little better, a little more, or something nicer. It is not in our nature to stop, sit down, and say, "I am content" unless it happens during a 45-minute yoga session, after which we must return to work, school, or home to clean up and prepare for another day. Our physiology demands food and water. Our social nature requires the company of others. Our intellectual curiosity rarely sleeps. We are consumers of everything around us—ideas, feelings, nourishment, and anything else to satisfy the insatiable.

Unlike the first three, the fourth human flaw in Unger's framework can be corrected. Belittlement is the ongoing and regular surrender of our higher ideals and desires for the sake of just getting along in life. And why is this belittlement? Because, "the individual knows himself darkly to be more, much more than his outward existence reveals," and each person experiences not a single death, but rather "death by instalments" [16]. We can transcend our current situation and analyze ourselves, our surroundings, and others. We can consume worlds and then remake them, figuratively speaking. We can do so much, and yet we do not.

The solution to our flaws is to embrace our mortality, groundlessness, and insatiability and throw off the yoke of belittlement—ultimately to live without illusions. The societal characteristics laid out by Unger that would support living this way may be applied to understanding a possible link between entrepreneurship and his philosophy. This link is based on a suggestion that entrepreneurship is more than just the act of starting a business, more than being a sub-category of the field of business, or more than the actions encompassing a start-up process [10]. If it is more, then we may look to Unger and compare what it is to live without illusions and what it is to be an entrepreneur. His model of society is relevant in this context, and its attributes are not so unrealistic given the current state of affairs in Finland and other parts of the world: the right of apostasy, higher cooperation, deep freedom, and plurality of systems. Briefly, apostasy is the abandonment of previously held beliefs—to turn away from what one once held as true. Higher cooperation is visible in self-employment, expert teams, white-collar networked production, and many low-hierarchy organizations. Deep freedom[1] is ongoing change to our institutions and our practices, not as a response to external crisis but as an intrinsic mechanism of organizing our social life, as is the case with innovation. Finally, plurality of systems means that we do not allow one idea

[1] *"Deep freedom, in its fullest sense, is the dialectic between the conception of a free society and the cumulative institutional innovations that can make this conception real" [17].*

or concept of social arrangements, like capitalism, socialism, or whatever new "-ism" we create, to become hegemonic. Everyone can try their own way—as long as it safeguards the empowerment of others and not their belittlement.

The attribute deep freedom leads us to focus on institutions and "the rules of the game." While it is easy to see how entrepreneurship encourages us to challenge our beliefs (apostasy), to work together in intellectual partnerships (higher cooperation), and to give each one an opportunity to find his or her own way (plurality of systems), it is Unger's deep freedom that resonates with us most deeply as we contemplate entrepreneurship.

Deep freedom is not a program of equality, a promise that everyone should have the same level of life, but rather that the life each currently has would be empowered and enriched. It is not synonymous with the neo-conservative abandonment of regulations and controls, giving the individual the right to do anything and everything for profit (financial or social). Instead, deep freedom is that place where imagining a free society meets the innovations that could make it a reality [12]. How this happens is a process that encompasses creativity, risk, experience, and meaningful personal engagements. We present a model based on Unger's work, which we call CREPEs (see Figure 1).

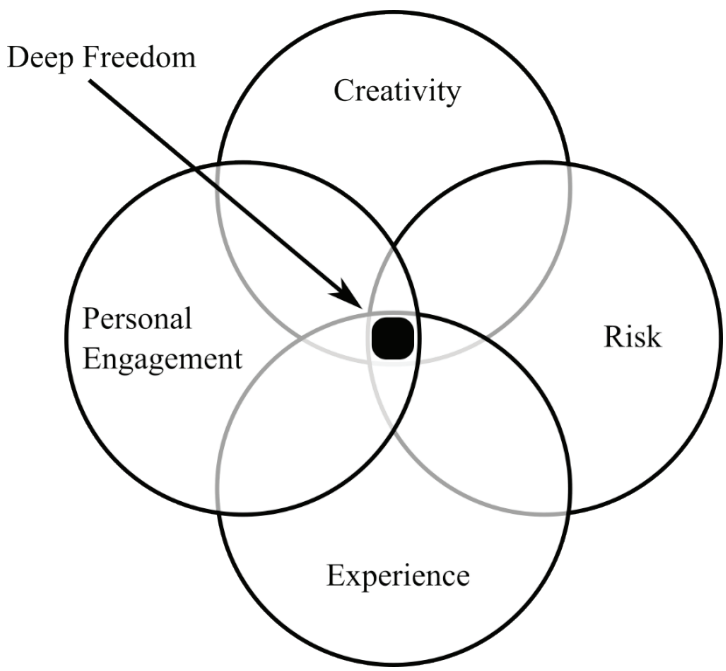

Fig. 1. *Deep freedom is CREPEs.*

In the discourse in and around entrepreneurship, these same terms come up regularly. There are entire branches of entrepreneurial research on risk [18], experience and serial entrepreneurs [19] [20], creativity in start-ups and corporate entrepreneurship [21], and of course, personal engagement of the start-up entrepreneur [22]. All four aspects inform the narratives of Steve Jobs [23], Sir Richard Branson and Bill Gates [6], and of course Elon Musk [24]. But what if entrepreneurship is more than just starting a business? One proposal is that it is like the scientific method, introduced during the Renaissance in Europe, and associated with Francis Bacon in the 1200s. We could "reformulate entrepreneurship as a method of human action, comparable to social forces such democracy and the scientific method, namely, a powerful way of tackling large and abiding problems at the heart of advancing our species" [25].

Some of these "large and abiding problems" are perhaps the outcome of what Unger calls our fatal flaws.

Given this background of our flaws—mortality, groundlessness, and insatiability—and a model to embrace them and live fully empowered, we reflect on our own lives in the face of regular encouragement to consider entrepreneurship as a career and/or lifestyle choice. Our hope is to shed light on how we experience these flaws and how we may perhaps consider entrepreneurship both individually and collectively, for the purpose of answering the question, "Why not become an entrepreneur?"

3 Methods

In this study, we used autoethnography to capture the authors' thoughts and opinions. It is a method that does not hide the subjectivity of the researcher but instead grounds itself on that subjectivity [26] [27] [28]. Each of the five authors has written four texts, one each related to the past, present, and future of our own lives, with an additional reflection on a theme in our findings. The initial 15 texts were analysed by each author using thematic analysis [29] and grounded theory tools [30] [31] to create a total of 244 points of data—lines that give rise to reflection.

The triangulation verifying what it is we are trying to say includes the author, the other writers doing the analysis alongside the author, and the theoretical themes arising from several workshops around the data. Cross-referencing and comparing the themes we applied to our own stories with those of the others and with aggregate themes from the workshops create a subjective snapshot of the phenomenon.

3.1 Autoethnography

A group of five students was tasked with writing a joint paper under the umbrella of entrepreneurship, this year's topic for the course Bit Bang at Aalto University. We were given a tremendous amount of freedom to choose what to study and how to study it. We looked around the table and asked if anyone had data that they were interested in sharing and working with in this group of PhD students. This was met with silence. Were there any topics we could explore that people found interesting? This was not met with silence but rather a total of 20 ideas generated over a few days in both face-to-face meetings and online discussions. Some of these were related to market timing, augmented intelligence (AI) and computer-generated imagery (CGI), social entrepreneurship, Greimasian semiotics, space exploration and tourism, professional gaming, and buying time. We narrowed it down to two topics—buying time and market timing—before we hit a wall. The barrier was not having interesting data or enough time to get some. Did we want to evaluate mobile applications that help people be more efficient in their use of time? How could we confirm that entrepreneurs had timed their market entry properly and not be accused of survivorship bias? Time and timing were recurring elements in every discussion.

The course was about entrepreneurship, and several of our guest speakers had been encouraging, if not downright challenging, on the topic of becoming an entrepreneur. However, none of us were openly planning to leave academia mid-studies and launch our own start-up. Yes, several of us have experience as entrepreneurs and business owners or have registered a business, but the concept of entrepreneur as an "either-or" decision did not sit well with us, and this gave us the idea to reflect on why. We thought our joint paper could be the setting for a discussion on entrepreneurship as a choice for us, explored as a discussion we were already having. And this gave us our data, in the sense that this was an ongoing phenomenon that we experienced, in which we were personally involved every single day—interesting data for us because it engaged each of us in fundamental ways. And the gap, if we would use that term, was that something was missing from the Bit Bang course and from entrepreneurial discourse in general, and it was making us uncomfortable or detached. What was that missing element?

As a reflection paper, more than a scientific article or an issue paper, we felt that the act of reflecting would involve the self—our subjectivities, our physical and intellectual being, and (in hindsight) our interrelationships. Who better to know what our interviewee meant to say, tried to say, and wanted to say, than the interviewee? Upon this question we then began to look at methods that al-

low authors to explore their own narratives and thoughts. We wanted to capture not only the psychological elements of entrepreneurship but also the cultural, social, and institutional frameworks in which we are embedded and from which we are able to step back and evaluate. This led us to autoethnography.

Auto – self. Ethno – culture. Graphy – writing. *Autoethnography* can be defined as the writing that arises from a study of the self in relation to the world. There are four characteristics that differentiate autoethnography from personal writing. Autoethnography includes "(1) purposefully commenting on/critiquing of culture and cultural practices, (2) making contributions to existing research, (3) embracing vulnerability with purpose, and (4) creating a reciprocal relationship with audience in order to compel a response" [32]. The one common characteristic each member of the team had was that they had moved to Finland and began studies for a PhD at Aalto University. This was the past. We were all doing research, living in Finland now, which gave us the present. And the theme of the course, entrepreneurship, posed the question,

"What would need to happen for you to consider becoming an entrepreneur?" This then entailed our future. We each wrote a text on our past, our present, and our future. To arrive at an answer as to why or when we might become entrepreneurs, we actually moved beyond entrepreneurial discourse and into social discourse, touching on the metaphysical. This is the strength, and also the weakness, of autoethnography: It leads you to consider your life.

3.2 Thematic Analysis

After generating our own texts on the past, present, and future, we relied on thematic analysis as the selected method for analyzing our data. Initially, thematic analysis is a method for identifying, analyzing, and reporting patterns (themes) within data [29] [33]. With the interest of exploring the topics discussed across our texts, thematic analysis seems suited for unveiling what each of the authors decided to discuss in their autoethnography texts.

As a structure method for analyzing data, Braun and Clarke [29] suggest six steps for conducting thematic analysis: (1) The researchers need to familiarize themselves with the data, which can happen through transcription (in case of audiovisual material) and/or reading the generated data. Next, (2) researchers should establish the initial codes; in other words, what topics are discussed across the data. After that, the work of merging and (3) searching for themes start, where the researchers look for patterns into the established codes. This step is followed by (4) revising the themes, where the codes are again compared with the data, (5) naming the themes, and finally (6) producing a written report.

In our group, we started the process reading each other texts and applying initial codes (steps 1 and 2). Each author of this paper was in charge of unveiling the most relevant topics found across the three texts generated by each of the five authors. Next, we organized a workshop, where using the support of whiteboards, we initially drew all the themes and started making connections and finding similarities in our data (steps 3 and 4). Finally, in the end of the session, the authors of this paper came across with the most common themes, where we merged and renamed the codes (step 5). Table 1 presents the topics unveiled in our data set, which will be discussed in the sequence of this paper.

In the next section, our text will change from plural to singular[2]. Each author wrote in the first person, using the words *I, me,* and *my* to situate their thoughts, actions, surroundings, and experiences. We want to share the experience of analysis of the self and the other [34] by blending our stories together in such a way that you, the reader, can see the red threads that arose both from our stories but also from the process of revealing what it is we thought and did. Therefore, the Findings section will have one voice, the I, and this I is five different people born in Canada, Russia, China, Brazil, and Romania. Each has embarked on a similar journey and made his or her way to Finland to earn a PhD.

3.2 Analysis and Findings

When I looked at all of my stories of the past, present, and future, I had a total of 15 different stories. My past life was there, when I lived in Brazil, China, Canada, Romania, and Russia. My current life, as a PhD student in Finland, was there. And my hopes and plans for the future were there as well. I was coding themes, and there were more than 200 statements that touched on my motivations, my plans, my values, and so many other things. When I stood in a classroom and sorted all of the most important ideas from each time period, using different colored sticky notes, a whiteboard and markers, and reflection, I saw that four dominant ideas persisted. They are family, career, personal development, and some kind of overarching theme of a good life, which would be perhaps the outcome of the previous three. Table 1 illustrates my process. After that, I open up what I mean by these four recurring themes in my life.

[2] *To reiterate – each of the five authors is writing in the first person (I, me, my), when analyzing the findings of our collective data, to illustrate the generalizable aspects of multiple autoethnographical accounts.*

Table 1. *My time, my themes, my life.*

Time	Themes	Common themes	Aggregate themes
Past	Personal development	Development Discontent Finland Family	The Good Life (composed of Family and Freedom)
	Language		
	Studying		
	Destination: Finland		
	Love Helsinki		
	Discontent		
	Financial constraints		
	Desire to be free		
	Extended family		
Present	Personal development	Development Career Freedom Family	
	Professional development		
	Experience		
	Career		
	Publication		
	Industry / Academia		
	Freedom		
	Family		
Future	Options for career	Professional options Family	
	Hope / Optimism		
	Motivation		
	Uncertainty / Questions		
	Industry / Academia		
	Entrepreneurship		
	Family		

Family. For me, family represents safety, comfort, and understanding. It is the "place" where I can get advice, give advice, feel understood by people on whom I can always rely. It is the environment in which people that I love and love me back are with me.

There can be a blood tie between me and family members, or not. Sometimes, I consider someone who is not related to me as family if I have known that person for a long time or feel particularly comfortable and safe with and trust that person completely, such as friends I have not seen for years but instantly reconnect with and feel as close as always when we meet.

There are two phases of family. The first one is made up of my parents who raised me, educated me, and tried to prepare me for life. The second phase is my lover, my spouse, my partner, and my (potential) children—a new family. Of course, these phases are intertwined and occur simultaneously in some respects. In some cultures and families, it can be very deep, nuanced, and inextricable; the stereotypical mother-in-law comes to mind, babying her 40-year-old son and telling his wife how to clean the house. Culture and social constraints have a big influence on families, as I could see from my stories about the different countries I came from.

I feel, however, that these two phases are at some level sequential in nature, rather than parallel. There is a generation gap that widened at some point and started to affect how I saw my parents' wisdom and knowledge. My partner or spouse understands me quicker than my parents do. Although I will always love my parents, the connection weakens, and I feel I am living my own life, harsh as it may sound. It is a bit like animals preparing their offspring for survival and cutting them loose in the unknown. Humans also let their children go at some point. I have been told by my parents that I will be a child, their child, for as long as they live; perhaps I will understand this when my own children are set loose in the wild.

When I think of family, right now, I think of my parents. I was fortunate to grow up in a great family with good communication and where I have been involved in every family matter from an early age. Also, my parents taught me how to do all kinds of things, which later proved helpful. I am able to take care of myself, cook, and fix things around the house, and I am not afraid to try new things. They helped me develop most of my hands-on skills.

Education is also something I owe to my parents. They have provided me with all the support available so that I would succeed in my studies. In turn, I have always tried not to disappoint them and to do well in school, in general. My parents have tried to convince me of the importance of education. Although there was no pressure for a master's or doctoral degree, there certainly was an expectation that made me leave home and go earn my bachelor's degree.

Family is what we are, in a way. When we grow up, our personality and choices are influenced by the education our parents provide. Later, when we make our own family, we find people with common ideas and ways of thinking, views on life in general. Thus, we always find ourselves in family, no matter what stage in life we are in, and the role of family to offer unconditioned love and support remains constant.

Career. Discussing my own stories, the topic of career comes up across different periods of time (past, present, and future). Career is both a core concept and an external driver for change. The key part of my stories were decisions toward certain careers, which motivated my move to a different country.

In my past, I found that career choices provoked a change in my life—the move to Finland. In describing the past, moving to Finland is for a future career improvement. As I wrote, "I wanted to go get an education from a prestigious university and see if that would open more doors for me." It is important to highlight that seeking for a career improvement did not happen without losses, as I wrote elsewhere, "I left friends and a job to come to Finland to improve myself."

Of course, a research career was a recurring topic in my stories because I am a PhD student. In writing about the present, the main topics were personal development, publications, and plans after my PhD. The present is the appropriate time

for discussions about the future: "With the graduation showing up in the near future, questions regarding what to do next start to come," and "I have started to wonder if my career should be the main priority." For me, research groups shape my career, both in the present and in the future. For instance, "I am more suited to doing scientific research." Already I see that the activities I perform are affecting how my career is being built.

A career in industry? This seems to be a hot topic[3] nowadays, given the disproportionate number of PhD graduates versus new positions in academia. As a result, recent PhD graduates are being forced to seek other career options than the traditional path of moving from PhD to post-doc researcher and then to tenure track.

As previously mentioned, my present affects my future career development. I do have wishes regarding how it might go, a career path, but it is perhaps a dichotomy between industry and academia: "My ideal life will be that of a scientist and researcher," and "I would like to get a job in industry and build some experience." My writings about the future, and therefore my plans about the future, can be seen as the outcome of my plans established in the past plus the current developments in the present.

Personal development. In my autoethnographic research, the thematic analysis revealed some recurring topics, such as personal development. Personal development covers activities that improve awareness and identity, develop talents and potential, build human capital and facilitate employability, enhance the quality of life, and contribute to the realization of dreams and aspirations [35]. Personal development takes place over the course of a person's entire life.

Looking at my own writings, personal development exists in all of my reflections on the past, present, and future. It is interesting to notice that in the past, personal development was mentioned only once, whereas it occurs often in writing about the present and future. Oddly enough, when I speak about the future, personal development entries are connected mostly to the professional development, like "getting experience from a large company." I would like to get more experience and develop certain skills further before taking any steps in the direction of entrepreneurship. In the present, my personal development is subdivided into physical development and development of tools necessary for my future career.

There are many ideas around personal development, one of which is Maslow's

[3] *For more information, see "Leaving Academia: How To Get A Job In Industry After Your PhD," http://www.nextscientist.com/job-in-industry-after-your-phd/; "Lost in Translation: The Value of a PhD Outside Academia," http://www.lateralmag.com/articles/issue-2/lost-in-translation-the-value-of-a-phd-outside-academia; "Young Scientists Ditch Postdocs for Biotech Start-ups," http://www.nature.com/news/young-scientists-ditch-postdocs-for-biotech-start-ups-1.20912?WT.mc_id=FBK_NatureNews*

theory of human motivation [36] in which he presents a hierarchy of needs to be a healthy human being (see Figure 2).

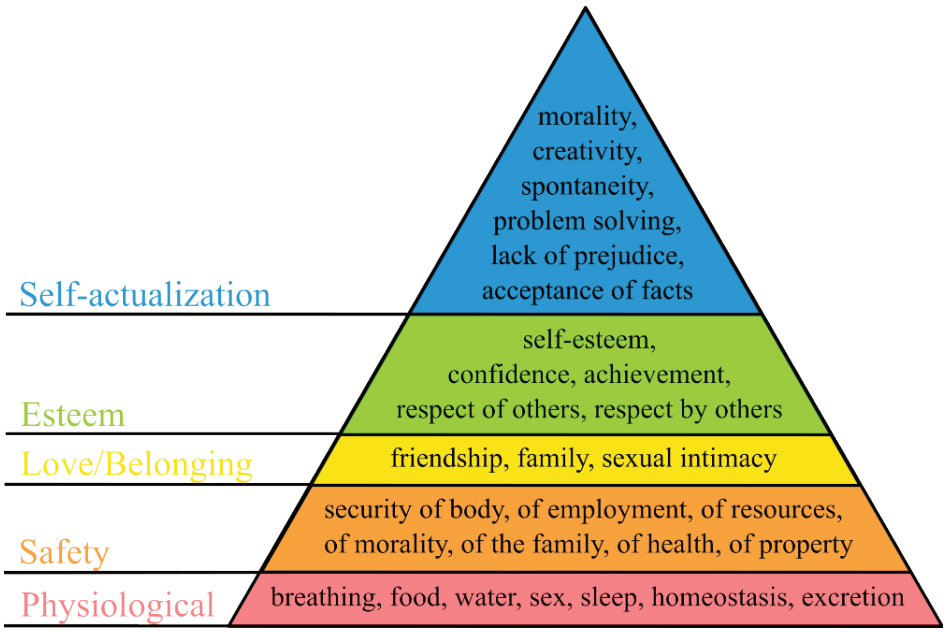

Fig. 2. *Maslow's hierarchy of human needs [37].*

If people are dominated by fulfilling their physiological needs, then all the other needs may be irrelevant. According to the theory, if both physiological and safety needs are gratified, then needs for love and affection emerge. As Maslow outlines, most people have a need for a stable sense of their own worth, a need for self-respect and respect from others. Satisfaction of self-esteem leads to feelings of self-confidence, worth, strength, and capability [37]. The fifth level refers to uncovering a person's full potential to become the ultimate self that he or she can be. Later in his life, Maslow explored another layer of needs, called self-transcendence. Here, people find actualization in giving themselves to a higher goal, for example in altruistic behaviours or spirituality [38].

In his work, Maslow notes that satisfaction of one set of needs doesn't have to be complete in order to see other needs. There is a relative degree of satisfaction, and it can be illustrated with arbitrary figures; for example, an average citizen might have 85 percent of physiological needs satisfied, 70 percent of safety needs satisfied, 50 percent of love needs, 45 percent of self-esteem, and 10 percent of self-actualization needs. Once some needs are satisfied, the next ones do not emerge suddenly but rather gradually by degrees [37].

In many ways self-actualization corresponds to my references to personal development. In the era of digitalization, personal development, self-development, or "self-actualization" has become a popular trend, with a whole field of literature, websites, communities, personal coaches, life-coaches, motivational speakers, and educational portals ready to help me start on a path of personal development. But why would I? In hindsight, and with a perusal of some of those sources of guidance, I feel that uncertainty leads me to adapt by developing myself. It could help me to move up the career ladder, remain competitive for new jobs, and cope with a quickly changing work environment. Perhaps it could boost my confidence and credibility. And somehow, I feel it provides new challenges. These could be defined as motivations or necessities in my present world. Professional development was a large part of what I wrote about the present and especially the future, and perhaps this is not so much self-actualization as satisfying more basic needs, including physiological and safety needs. A home to sleep in. Money for food. A country with good health care.

It seems that the topic of personal development arises in my writing about the present and future, but not the past. Why is this? Perhaps Unger is right and I am insatiable—never satisfied—and cannot stop developing (in the present) from what I was (in the past) toward something I am not yet (in the future). It is as though I live in and for the future. And that future, as I discovered in the thematic analysis, and in my reading looks a lot like Maslow's self-actualized and self-transcendent person, living a good life.

The Good Life. "What is a Good Life?" For me, when I see scenes on television where the whole family is living happily together, I feel that they live a good life. When I was younger, I dreamt of buying a beautiful apartment for my grandparents. A good life then was having enough money to buy things that fit a certain definition. Since my grandmother died in 2010, due to incorrect treatment of a cerebral hemorrhage, every time I hear Mariah Carey's song, "Bye Bye," [39] I burst into tears. A good life now is that my family is healthy and alive. But a good life is still more than this. It is full of positive emotions, including pleasure, trust, gratitude, serendipity, and happiness.

For example, at work I had a wonderful supervisor who trusted and supported me. I was so grateful for all the interesting things I was doing every day. The experiences of being and working with my colleagues, getting to know them and be in a supportive network with them—"sharing and caring"—is a tremendous resource. While there are a few negative people who like to gossip, I simply avoid them or at least not engage much with them. My future will be in a job that allows me to develop my knowledge and utilize my professional skills and expertise.

In my daily life, I get much more satisfaction from my marriage than from

work. One reason for that might be I consider my spouse to be my best friend and colleague. We ask specific and meaningful help from each other to reach our personally developed plans and goals. Another reason is that my spouse takes such good care of our child, who is also my pride and joy. We are enjoying our lives together. These emotions are felt in the present, and they make the journey of life colorful. While those colors fade with time, what endures is meaning.

Since I live in a stable situation, I thought that it's time for me to become a giver, someone who helps others. I began donating regularly to the Red Cross, to support education projects directed toward poor children. Presently, it is only 15 euros a month, but I am waiting to hear from the local RC office regarding making a larger commitment. Another way in which I give is that I became a supporter of PETA (People for the Ethical Treatment of Animals). I have been disseminating information to my friends to stop purchasing animal fur and leather products, and I do not visit any commercial shows with animals.

There is one point that I hold onto: I cannot make a sacrifice for a greater good. I only make commitments I can keep and will not take on greater stress or anxiety. I appreciate Viktor Frankl's writing, and while I cannot image how he lived through the horrors of a Nazi concentration camp, I respect his views on life. He wrote, "If there is meaning in life at all, then there must be meaning in suffering". However, for me, choosing to have a good life means avoiding negative experiences or events. Yes, there is suffering, but the meaning is elsewhere. Enjoying life, being positive, being happy, being a giver, I am achieving a good life.

3.3 Summary of findings

Where I came from, what I am now doing, and what I hope to be doing in the future are revealed in the analysis of my writings. Past. Present. Future. These point to family, career, and personal development, which in hindsight are the components of my good life. Family has been an important part of my life and will be in the future, as well. Moving to and staying in Finland are very much interwoven with the threads of my parents, intimate partner, and children (both existing and potential), and this is something that stays consistent through my past, present, and future. Career is the topic I had in mind when I began this study, triggered by that question, "Why not become an entrepreneur?" and career is the reason I am at Aalto University working toward my PhD. This is closely tied to personal development, as education is one way to develop my intellectual life and my financial life—so that I could get a mentally stimulating job. But that job, that work, that mixture of activities that I think of as "career," what does it do for me? In my findings, I realize it means freedom. Freedom to do the kind of work I want, in a

place and with the people I like. It allows me to provide financially for my family (in an extended sense). Ultimately, the side of personal development that feeds into career—namely, my PhD studies—facilitates freedom and a good life. When I write about my good life, it is not written in stone. It can change, evolve, adjust, and be completely replaced by a new vision. When asked about entrepreneurship as an option, I would say, "It depends on a lot of other things than just starting a business."

4 Discussion

Moving away from the singular subject, the "I, me, and my" to a more traditional "we" or "one," we look back at Unger's claim that we are struggling with our impending death, our groundlessness, and our insatiability. As well, we will touch again on the idea of belittlement (or compromise), and all this in the context of our self-told and self-analyzed stories.

When looking at the outcomes of our research—namely, the themes of family, career, personal development, and an aggregate we call "a good life"—we can relate these to Unger's position to reveal any connections. First, mortality. In this struggle with mortality, we are cognizant of time before and after our lives. Particularly, we reflect on our grandparents, parents, and our (potential) children, their children, and so on. It can be claimed that we live on, in some social and biological sense, in the lives of our descendants, and that our ancestors live on in us—in our behaviors, social conditioning, and genetic heritage. Perhaps in some social sense, we are addressing our mortality through placing ourselves within generations of family.

Career is something that we are not sure of, at the moment. As PhD students, we have offers and possibilities now and coming. But like family, there is a certain time frame or temporality attached to it. Now, we are doing this. Later, we may do that. The planning orbits around a central point—doing—and doing things leaves behind a trail of effects on our environment, circumstances, and the situation in which we find ourselves living. So career is perhaps a way of becoming rooted or grounded in the social, economic, and professional fields of our lives. While Unger contends that we struggle with groundlessness and cannot ever repair it, we feel that pursuing a career is our own way of building foundations in the world. While none of us mentioned it, some people feel that they must leave a professional legacy, a business venture that affects the world, and this too can be a response to our mortality.

Insatiability, Unger's term for that undying search for satisfaction, is revealed

in our own stories of personal development. Pursuing a PhD is not only about family and career, but also about becoming better, more capable, more useful, and more (fill in the blank). This is not a bad thing. We are not chasing after gold to store up and hide from the world. Rather, we are developing ourselves to achieve a certain freedom to choose—to choose what we will do and where we will do it. So while Unger says this is an irreparable flaw that we will never overcome, we might respond, "Good that we never overcome it!" Why would we desire complacency? Waking up every morning hungry for experience, hungry for life, may be permanent but our response is healthy. We are driven to finish our studies, to exercise, to eat (reasonably) well, and to learn.

A good life, as we have expressed it, encompasses our responses to the fatal and incorrigible flaws that Unger puts forward. Our family helps us deal with our own mortality. Our careers are a way to plant roots in a groundless environment. Our personal development is driven by our insatiability. And all of these combined demonstrate how we correct that one flaw that Unger says can be corrected—belittlement. This last, as we mentioned before, is "death by instalments" [16], constant or regular compromise of our higher ideals, our dreams. The good life is composed of the daily, small actions that are motivated by our higher ideals, and these actions are manifested in our family and in our careers.

Entrepreneurship offers possibilities to be creative, to take risks, to gain experience of the natural and social world, and to be meaningfully and personally engaged with what we do. Each of these aspects are listed in Unger's response to our fatal flaws. We need these to experience deep freedom, and they are there in entrepreneurship. This is a virtuous circle of sorts. However, in our own autoethnographical accounts, we also find creativity, risk, experience, and engagement in other things. What entrepreneurship offers in terms of calming our fears and addressing our weaknesses is also available in family life, in an academic career, in hobbies and volunteer settings. This group of PhD students finds that entrepreneurship, or the entrepreneurial ideal, is applicable to and therefore a subset of the greater ideal of life, personal and professional. It is one potential part of a good life.

5 Conclusions

The objective of this paper was to reflect on the challenge given us by one of our speakers during the Bit Bang course in 2016–2017 at Aalto University, "Why not become an entrepreneur?" It seemed a simple and personal question, so we decided to write autoethnographical accounts of ourselves and analyze them using

thematic analysis. What arose from the analysis was that any discussion about entrepreneurship quickly moved to what we are currently doing and what we might do in the near future, professionally speaking. We had this in common: We all migrated to Finland and are presently doctoral students in Finland. Migration and education were in our past and present stories, while personal development was more present and future focused. And yet, when asked about what these three themes do for us, the consensus was that each of them facilitates freedom in some way. Moving to Finland gave us freedom from the home institutions. Our education will give us freedom to move elsewhere, work in fields we want, or provide financially for ourselves. Personal development prepares us to survive and flourish in the future. In the background, always present, was the only theme that we found in each time period (past, present, and future)—family. Therefore, we concluded that family and freedom were our dominant themes. At the end of our analysis, we explored what it is that these two themes do for us, and we agreed that they are outward manifestations of a good life.

In the Findings section, we show how it is that Unger's "fatal flaws" of human existence—mortality, groundlessness, and insatiability—are somehow pacified or calmed by our behaviors. We deal with death through family. We embrace our groundlessness by continually rooting ourselves in our careers and social experiences. Our insatiability is turned into personal development, a healthy response to an incurable disease, perhaps. And ultimately, we do correct our flaw of belittlement by choosing to live a good life—our good life.

The implications for discussions around entrepreneurship in PhD-level courses are three-fold, going from the macro to the meso to the micro level, and back again. At the macro level, each student must have an opportunity to explore what it is he or she would like to achieve in his or her professional and personal life—to clarify a personal meaning of a "good life" and to reflect on how entrepreneurship can be a part of that life. This would place entrepreneurship within a portfolio of professional and personal development options, including industry work, academic work, and not-for-profit activities. At the middle or meso level, an opportunity should be given to reflect on the underlying themes of entrepreneurship, namely creativity, risk taking, experience, and personal engagement, so that students can understand how each of these manifests itself in entrepreneurial work. This would be a catalogue of what entrepreneurship looks like in real life. Finally at the micro level, Sarasvathy and Venkataraman's proposal that there is a "distinct method of human problem solving that we can categorize as entrepreneurial" [10] should be explored in a method of daily practice for PhD students to do entrepreneurship at work, at school, and in their personal lives.

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Pay It Forward: Circular Economy Approach

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ABSTRACT. *As we have become more aware of the limited resources of our planet, new resilient approaches for production and recycling of waste materials are sought. A circular economy is an industrial economy that promotes greater resource productivity aiming to reduce waste and avoid pollution by design or intention. The aim is to create closed loops where biological or technical nutrients circulate at high quality in the production system without loading the biosphere. This is in contrast to a linear economy, which is a "take, make, dispose" model of production. In industrial production, it is easier to create closed loops where surplus such as excess materials or heat from other production lines are used in other operations. However, the circular economy is strongly promoted to be integrated also to societal and urban functions, where the creation of closed loops is not in the same way self-evident and apparent. In this paper we will concentrate on how the local circular economy can be enhanced and what kind of business opportunities it can offer. Different business models and scales to implement a circular economy have been examined. Additionally we have been interviewing some experts on this concept to reveal different requirements for creating a local circular economy. As a result we will discuss what kind of new possibilities the circular economy model creates for start-ups and other companies and how the public sector can support this development.*

KEYWORDS: *circular economy, business model, operational scale, waste reduction*

1 Introduction

We now produce 20 times more plastic than we did in 1964. The amount of bottles, wrapping, and hard plastic lids is expected to double in size in the next 20 years, according a 2016 report by the Ellen MacArthur Foundation[1]. If we do not slow this trend, there will be more plastic in the sea than fish by 2050. We need to improve the way we design, use, and recycle plastics so that less is thrown away and more is reused. This is called a *circular economy*.

In a world free of human beings, a circular model exists naturally; one species' waste is another's food. Energy is provided by the sun, and living things grow and then die, which returns nutrients to the soil safely. Humans, on the other hand, have adopted a linear approach based on three steps: fabrication, usage, disposal. Raw materials are transformed into trash, but unlike the circular model, trash cannot be transformed back to raw material, and in some cases it is even toxic. Over time, the linear model reaches a point where all raw materials are used up.

We as mortal beings are just borrowing the environment, the richness of resources of the world. Using these resources makes us indebted. As we do not want to pass too heavy a burden for subsequent generations, we should pay our debt forward in manageable terms and reuse as much as possible. Thus, the solution is to transform the linear approach into a circular economy (CE), where waste does not exist. A circular economy is restorative and regenerative by design and aims to keep products, components, and materials at their highest utility and value at all times (Ellen MacArthur Foundation). This can offer several new possibilities for start-ups and other companies. However, this development is not self-evident. New business possibilities need to be identified, and the public sector should encourage and conduct this development. If we succeed in this development, the CE offers the potential for economic growth, innovation, and jobs as well as for a strong reduction of the impact on the ecological footprint and carbon emission.

The CE has gained worldwide importance in recent years. The European Commission adopted an ambitious Circular Economy Package, including revised legislation proposals "to stimulate Europe's transition towards a circular economy, aiming to boost global competitiveness, foster sustainable economic growth and generate new jobs."

In this paper we present a review on the development of the CE approach and discuss what kind of new possibilities the circular economy model creates for start-ups and other companies and how public sector can conduct this development. We are approaching the concept of the CE in the Finnish context. Thus, findings can be extrapolated but do not necessarily fit in every context.

[1] *https://www.ellenmacarthurfoundation.org/circular-economy/overview/concept*

2 Definition and Roots of Circular Economy

The circular economy is an industrial system that is restorative or regenerative by intention. It aims to eliminate the use of chemicals that can impair reuse potential. At the same time the production system is changed toward the use of renewable energy and waste elimination. It is essential that production is transparent by nature. Materials and end products are well defined in terms of substance, composition, and origin and suitable to be used as nutrients or reused in products [1].

Within a CE, three economic functions of environment should be reflected in industrial production: provision of resources, life support system, and sink for waste and emissions (Pierce & Turner, 1989). Also, industrial ecology has introduced the concept of closed cycles that can lead to less wasteful industrial processing.

According to the Ellen MacArthur Foundation [1], the circular economy rests on three principles, each addressing several of the resource and system challenges that industrial economies face. First, we should preserve and enhance natural capital by controlling finite stocks and balancing renewable resource flows. When resources are needed, the circular system selects them wisely and chooses technologies and processes that use renewable or better-performing resources, where possible. Natural capital is enhanced by encouraging flows of nutrients within the system and creating the conditions for regeneration of, for example, soil. Second, we should be optimizing resource yields by circulating products, components, and materials at the highest utility at all times in both technical and biological cycles. This means designing for remanufacturing, refurbishing, and recycling to keep components and materials circulating in and contributing to the economy. Third, we should foster system effectiveness by revealing and designing to eliminate negative externalities. This includes reducing damage to human utility, such as food, mobility, shelter, education, health, and entertainment, and managing externalities, such as land use; air, water, and noise pollution; release of toxic substances; and climate change.

Ghisselini and colleagues [2] have studied the implementation of the CE approach. Movement toward more sustainable use of resources and decreased waste production has started already a half a decade ago. For example, Germany introduced the Waste Disposal Act in 1976, and the United States established regulations such as the Resource Conservation and Recovery Act in 1976. Most U.S. states have adopted since the 1980s a solid waste management hierarchy placing reduction and reuse at the top of the hierarchy. The CE in Japan was initiated from 1991 with the Law for Effective Utilization of Recyclables. Other

Asian countries such as Korea and Vietnam have been following with similar acts at the beginning of this millennium.

The CE approach varies from country to country. While in China, the CE is promoted as a top-down form of national political objective, in most Western states and Japan, there has been a bottom-up approach in which the CE is promoted as a tool of designing environmental and waste management policies. It should be also noted that while some governments and international organizations have recognized the problem of scarcity of resources, it still mainly is a NGO-driven concern. Only a limited number of countries have taken preliminary actions toward a CE, and a stronger commitment is still required.

The circular economy is not new, as can be seen from Figure 1, which shows a societal development typology reflecting development in Western countries. If considered from a larger perspective some, aspects of the CE are familiar from the pre-industrial era. During the agrarian era, there was a lack of resources, and they were used deliberately. Production was mainly local. During the industrial era societal development and production efficiency allowed unlocking vast resources all over the world while creating more and more waste. This development has caused global scale problems such as environmental pollution, climate change, and mass extinction of species.[2]

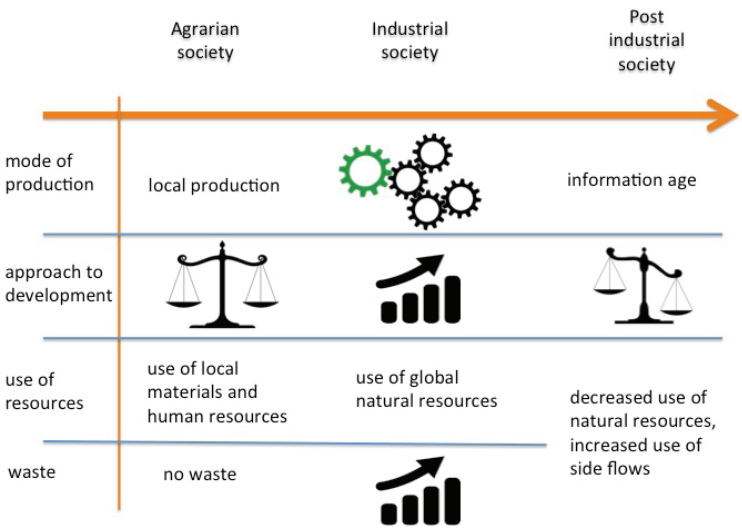

Fig 1. *Societal development typology and circular economy.*

[2] *While there has been several mass extinction events throughout millions of years, this currently ongoing "Holocene extinction event" is the first one that has been single handedly linked to human involvement; look, for example, to Pimm, S. L., Russell, G. J., Gittleman, J. L., Brooks, T. M.: The Future of Biodiversity. Science 269 (5222): 347–350 (1995).*

We are currently beginning to experience again the scarcity of resources, but now on global scale. World population growth and increased consumption are leading to a worldwide scarcity of several natural resources, such as critical natural resources like oil, water, food, and precious metals. Such scarcities may threaten commercial activities over the course of this century. Even if scarcity is experienced on a short- to medium-term basis, and is therefore only temporary, the experience is real and often felt directly by businesses and consumers. For example, the impact with regard to rare earth minerals has been felt in electronics and other manufacturing. This has demanded a change of thinking, and new approaches such as CE are needed. We need to find a way to live in balance with natural systems supporting our existence and decrease the use of virgin resources.

3 New Business Models

Because the opportunities and actions related to the CE are so many and varied, it can be claimed that it is like an umbrella collecting a large variety of subconcepts from reuse to recycling and sharing. McKinsey has created a framework known as ReSOLVE, which comprises six ways to bring circular principles to life: regenerate, share, optimize, loop, virtualize, and exchange [4]. We will provide some examples of new business approaches based on the ReSOLVE framework.

3.1 Regenerate

Regeneration as a business model requires a shift to renewable energy and materials. The aim is to reclaim, retain, and restore the health of ecosystems and return recovered biological resources to the biosphere. An example is the HorsePower business offered by Fortum [5]. HorsePower provides service to two main customer segments: from one side, energy companies capable of burning horse manure as a solid biofuel and from another side, horse stables willing to dump horse manure in an effective way. HorsePower takes care of transporting the horse manure from the stables and to the energy company where the manure is burned. As a consequence, this CE solution contributes more local jobs and activities while boosting renewable energy production. The service has been first implemented in the vicinity of Fortum's power plant in Järvenpää in Finland. Currently, HorsePower has pilots in several places running in cooperation with other energy companies. So far, HorsePower is providing the service to a significant number of stables, and the employees are also developing other services in addition to horse manure collection. Apart from Finland, HorsePower is targeting other countries, such as Sweden and

Germany. The potential of energy produced from horse manure is huge: One ton of horse manure is equivalent of 1.5MWh.

3.2 Share

In the sharing approach goods such as cars, rooms, or appliances are shared by a group of users. The life span of the products is prolonged through maintenance, design for durability, and upgradability possibilities. This approach diverts from a product and ownership-oriented mode toward a more service and co-ownership mode. Examples include ride sharing services such as Blabla cars or MaaS Global's attempt to change the whole mode of thinking regarding mobility and transportation without a requirement of ownership. These companies reduce the need for vehicles in "active use" by increasing the effectiveness of how much each single vehicle is being used per day. In addition, sharing economy accommodation services such as AirBnB are, at least in principle, beginning to reduce the need for building new hotels or other accommodation services. Simultaneously, the service will make better land use by increasing use of otherwise vacant apartments.

3.3 Optimize

In optimization product performance is increased. Waste production is removed from production and supply chain. Technically, this model has been in use in production. However, in the production model, the expected outcome is just optimized output without further consideration for what happens at the end of product's life cycle, besides optimal outcome where the consumer acquires another product as a substitute. Now this new model would extend production optimization beyond production output.

Optimizing also includes possibilities for the leverage of big data, automation, remote sensing, and steering. By 2050, an estimated 25 billion to 50 billion devices will be connected worldwide. On the one hand, this digital transformation will be only possible by using finite raw materials, the same ones that we have been using for decades. Thus, it is clear that the world needs a new model of developing electronic devices. One other hand, these connected devices will be a primary source of information. The pervasive connectivity they will offer will make possible to track material flows effectively, providing accurate information on where raw materials are needed and from where these materials can be recycled. Since we are living the Internet of Everything, why not benefit from its true potential while conserving finite resources [6]?

3.4 Loop

The loop approach is based on recycling materials, remanufacturing products and components, and extracting biochemicals from organic waste. The products are designed for recycling, with their end of product life cycle in mind so that all the parts can be salvaged to recycle as easily as possible. The design is not limited only to product design but rather extended to the whole service ecosystem required for optimized reverse logistics and recycling processes. A classic example of this kind of design is the Scandinavian system for recycling bottles. Also, many examples of implementing of this business model can be found from the forest industry, which has undergone large scale reformation during the past decade. In Central Finland Metsä Group is building a new biotech plant in Äänekoski. It is the biggest investment in the history of the Finnish forest industry, EUR 1.2 billion. Its employment effect is more than 2,500 jobs throughout the value chain in Finland, with 1,500 new jobs being created.

The Metsä plant is the world's first new generation of bio-manufactured products. In addition to high-quality pulp, it also offers a wide range of other organic products such as tall oil, turpentine, biogas, product gas, and sulfuric acid. Potential new product streams are textile fibers and lignin alloys. From inception, the plant has been designed to enable a wide and diverse range of products to be produced to create a unique bioeconomic ecosystem of companies. In the target state, the biotech plant will not produce waste for landfill. Getting to the target site takes several years after the start of the project [7].

It is also interesting that some ancient production models are introduced as new loop business models. An example is aquaponics, where fish and some grains such as rice are used to create a closed loop. Aquaponics has recently gained popularity as a sustainable way to produce food, and different kinds of DIY kits and introductions can be easily found.

3.5 Virtualize

In virtualizing business, previously concrete products are consumed partially or totally virtually. This business model has flourished in the 2010s. The most familiar example may be Amazon and its e-reader, the Kindle. Tablet computers, or even computers in general, are separating us from physical books. Wikipedia has been wearing away the encyclopedia industry for almost a decade now. In the music industry, streaming services such as Spotify have come to change the terms of the game. Streaming extends to other sorts of entertainment due to increased bandwidth. Customers not only listen to music online but also stream movies

and download video games without a requirement to own a physical copy. It is worth noting that this kind of business model requires accessibility to end-user access points, namely computers and smartphones, accompanied with sufficient network infrastructure. While that is reality in most of developed countries, it is not so all over the world.

3.6 Exchange

The exchange approach alters the existing production mode. For example, old materials are replaced with advanced renewable materials. New technologies like 3D printing can be introduced or the business model changed. Nowadays, we know that when we purchase a mobile phone, it will become obsolete within two to three years, after which it will end up in trash: All the products have a "end-of-life" date. The new business model is focused on restoration of obsolete products. Instead of purchasing, for example, a washing machine, we will rent the machine from a company that will take care of its proper operation, and when the machine reaches its end-of-life, the company will take it back and renovate it. This new concept of business model is totally different than we are used to do today, because it is not based on recycling products and reusing materials; it based on renovating our products and recycling obsolete components [8].

4 Scales

Another way to perceive the emergence of the CE approach is to examine what kind of CE activities occur globally, regionally, and locally (see Figure 2). While this kind of classification is artificial in the sense that very rarely these activities occur purely on one level, it is a useful tool to help paint the bigger picture on what the CE is all about.

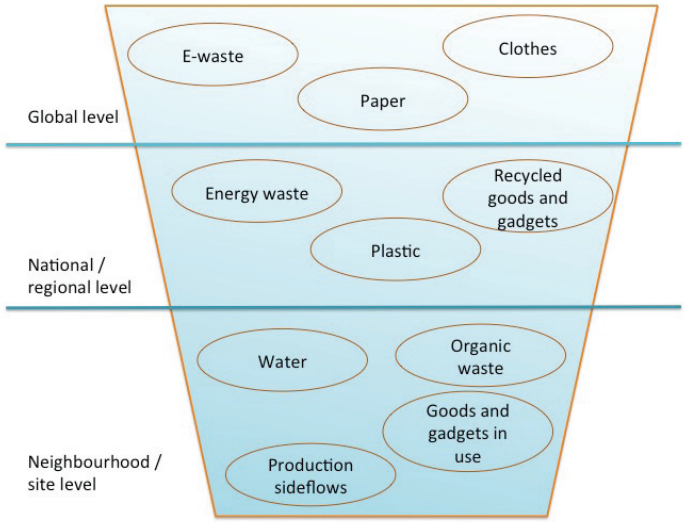

Fig 2. *Circular economy activities on global, regional, and local levels.*

4.1 Global and Regional Scale

Business models for CE on a global scale are well established. For example, used paper and clothes are shipped to China for recycling into raw material for new products. In addition, processes to reuse e-waste have been developed, but excess capacity remains. For example, in the European Union, 256,000 tons of e-waste were created, and 81,000 tons were collected in 2008 [9]. The amount of recycled and reused waste has increased steadily in each succeeding year [10]. There is a clear economic incentive as the market price of many metals has been rocketing.

In Finland on the national and regional level, existing companies are operating, for example, with recycling and reuse of energy waste and decommissioned goods and gadgets. Emerging business cases are also being piloted for reuse of plastics, which are typically light and well suited for recycling. Recycling processes only need to be developed to be comprehensive and cost-effective [11].

4.2 Local Scale

The effectiveness of reorganizing different material flows seems to related to the weight of the materials. It is not economically sound to relocate constant heavy flows such as water or organic waste. Also, business models that are based on a sharing economy, such as joint ownership of goods or utilization of production side flows, are more successful if there is no need for transportation. Attempts

to implement the CE approach on the neighborhood or site level are only slowly emerging. The challenge is that in order for a CE to function at least moderately comprehensively and efficiently, it requires a platform that can sustain an ecosystem of stakeholders that manage different aspects of CE solutions. However, there are a few success stories. The Kalundborg Symbiosis in Denmark is one of the most successful eco-industrial parks in the world. In Japan and Germany, some real progress has been achieved in the field, and China seems to be following that path as well. Finland boasts two interesting urban development projects, Hiedanranta and Kera, where a circular economy on a local scale is part of the project objectives.

The Hiedanranta district is located on Lake Näsijärvi, four kilometers from the center of Tampere city. Hiedanranta is an old industrial area on the former site of the Metsä Board's pulp mill. Plans call for the site to be developed into a new, compact urban area with up to 20,000 inhabitants. The development will incorporate dry toilets, which use less water and energy than flush toilets. They also facilitate the recycling of nutrients by collecting urine separately for use as fertilizer in microalgae growth experiments on site.

Researches are also piloting micro-algae growth in northern conditions as well as the use of algae in wastewater treatment. The pilot project also examines the use of micro-algae in bio-based products, fertilizers, energy, and even food. There is potential to use feces to make biogas, instead of using energy for pumping waste water to treatment plants where even more energy is required for water purification.

Kera is a former industrial area in Espoo, where a ceramic factory and other businesses have shut down since the 1960s. The area of industrial use along excellent rail links is now being developed into a vibrant city of the future. The City of Espoo wants to build housing for 14,000 inhabitants and create 10,000 jobs in Kera with emphasis on public transport and walking. The new development has been boosted with an approach of local circular economy, human-oriented housing, and community development. The concept is also seen as a potential export product, as the new sustainable Nordic urban development is believed to have demand around the world [12].

5 Requirements and Challenges

According to expert interviews conducted in the spring of 2017, there is some progress, but large-scale changes to achieve a circular economy take time. If society truly wants to achieve full CE potential, drastic changes are needed. Only changes in the whole system and its business models have a large impact on the whole. These kinds of radical changes are still in their infancy. According to

experts on the field, it seems the showcases presenting CE are always the same ones, which raises the questions of how much progress is happening and whether companies will be able to scale their business models.

In new economic perspectives such as a sharing or circular economy, the biggest challenges are most likely to be faced with legislation. One famous case of companies struggling with national legislation is that of Uber. The company has been involved in more than 170 lawsuits in the U.S. alone [13]. Strong government policies to mainstream circular business are crucial to reap the benefits of CE. The aim of governments should be to create an operating environment to enable systemic change toward a circular economy society. Finland is one of the countries where such an endeavor has started. In 2016 Sitra published Finland's circular economy road map for 2016–2025, which discusses several key policy actions for Finland to encourage a circular economy [14].

Governments should provide financial incentives for a circular economy. The development could be accelerated by means of funding. Sitra suggests that existing public funding instruments such as investment subsidies granted by the state could be focused on projects that implement CE principles. The next step would be to make all projects that receive public funding, such as construction projects, to comply with CE principles. The circular economy would also benefit from export promotion. Public procurements should focus on purchasing sustainable services and products that support the circular economy. The aim would be to produce minimal waste and support recycling and the use of secondary materials.

Sitra [14] states that there is need for education to create a long-term attitude change and influence the next generations. The circular economy should be integrated in education at all of its levels, and a sustainable way of life should be made a part of teacher education. Promoting CE should also be a part of the criteria when directing research funding.

Not only should the government create incentives but also eliminate existing regulatory barriers. At their best, policy instruments can have a stimulating effect on the economy. Norms can provide pioneer companies with a competitive edge, as in the case of environment norms, that have been found to create profitable business. However, according to Sitra [14], at the moment regulation is fragmented and consists of several different policy instruments. New policies are applied without evaluating the former mechanisms and their validity. At the moment different administrative branches have several different strategies concerning issues related to the circular economy. There is a need to review and coordinate this entity. Also, by changing the focus on taxation that supports sustainable growth, governments could promote the circular economy and the use of secondary raw materials.

Interviewees recommended that governments seek cooperation with the private sector to create new opportunities. It would be crucial for governments to create opportunities for companies and other CE actors to come together. Also new means of funding, such as collateral financing and crowdfunding, could be created to support a circular economy. The public sector could help businesses to create digital platforms where they could provide information on local material flows.

One of the biggest challenges in the CE field is the stiffness and incoherence in urban planning. There are usually multiple separate units in a commune that are working without proper communication with each other. All these units should have common goals to get the circular economy rolling. It will be a challenge for municipal governments to take their position as the leaders in this progress. There is also a need for change and new solutions in land use planning systems and practices. Small CE businesses require land to launch, test, and refine their solutions, as their business model may need facilities for fertilizer production or chemical processing. This is not only a coordination issue but also an issue of education.

When circulating materials in small countries like Finland, the challenges rise from the combination of long distances and small volumes. The raw materials are still too cheap to make using waste materials profitable. The costs of district heating are so low that it is not worth it economically to invest in heat recovery ventilation, even in old buildings.

In some cases, technological development in dragging behind. In such fields as handling textile waste mechanically or chemically or in recycling technologies, the technology itself is expensive and only works on high levels such as with construction waste. There is huge potential here: Optimizing business models and taking these technologies to the next step would create multiple new opportunities.

Other areas with great potential for growth are withdrawing nutrition and various digital applications that ease the use of waste materials and other resources. Also solutions such as 3D-printing, which help make high value-added products from waste materials, carry with them a lot of potential.

All in all, there are multiple common actions governments could execute and support for the circular economy to make progress. Barriers, such as lack of coordination and issues with urban planning, need to be tackled for the CE to function effectively. New financial incentives, more efficient cooperation, and education for both public and private sectors would create new possibilities for CE. Legislation is a challenge: It can create both huge barriers and opportunities for new businesses to blossom.

6 Discussion

The circular economy refers to an industrial economy that is restorative by intention; aims to rely on renewable energy; minimizes, tracks, and eliminates the use of toxic chemicals; and eradicates waste through careful design [1]. Based on these principles, McKinsey has identified six actions that represent different business opportunities. These actions all increase the use of physical assets, prolong their life, and shift resource use from finite to renewable sources.

For the CE to become mainstream, these actions need to be implemented systematically, not just by taking random steps in the direction that seems fit at the time. Accelerating this transformation requires a simultaneous approach on various levels—global and national multi-stakeholder collaboration for large-scale systems change combined with specific localized systems change in neighborhoods and cities. This means there is a serious need for coordination and education. Exchanging good and bad practices, communicating and raising awareness on the importance of a CE, providing opportunities for networking, and ensuring legislative coherence are all actions that are likely to require governmental assistance to happen. People lack knowledge, understanding. and proper successful examples. Perhaps success of platforms such as Hiedanranta and Kera will form a crucial part in changing minds.

For companies to take action, there needs to be economic value at stake as well as social value. Companies need to be able to identify and prioritize strategic CE opportunities. They need to be sure that they can create value with little or no new material inputs. As many resources are likely to get more uncontrollable in price and unpredictable in availability, that is an attractive business proposition. In the light of emerging signs of scarcity, improving the productivity of materials and natural resources is a crucial competitive response at the company level. That is why governments and companies have started looking at the CE model not only as a hedge against resource scarcity but also as an engine for innovation and growth. We suggest this opportunity is real, and it is opening multiple promising possibilities for pioneering companies and governments alike. CE could be the manageable way for us to pay it forward.

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Appendix: Methodology

The type of research used in this study is qualitative research based on interviews, specific case examples, and existing research. At first, our target was to find relevant research close to our research topic in order to understand the current situation. Next, national and international cases relevant to our research topic were studied. For those on a national level (Finland), we sought out a contact person for an interview for deeper understanding of the current situation and views on future expectations of the field experts.

Interviews were made in March and April 2017 by mail, phone, or personal meeting. The five interviews conducted for this research lasted from 30 minutes to one hour. All informants were eager to share their knowledge and understanding on the circular economy.

In selecting informants, we tried to reach both expert and entrepreneurial points of view. Informants included:

- **Maarit Särkilahti**, a PhD student in Chemistry and Bioengineering at Tampere Technical University, who is participating in research projects related to the development of the Hiedanranta district in Tampere
- **Maria Åkerman,** principal scientist at VTT with an interest in the circular economy and environmental politics
- **Nina Aarras,** who works in CE-related projects in Sweco (her PhD thesis, *One Company's Waste Is Another's Raw Material: Recycling and Remanufacturing as an Economically and Environmentally Sustainable Business Opportunity,* 2015, addresses recycling possibilities of waste materials in southwest Finland)
- **Laura Järvinen,** a CE expert in Sitra looking for ways to accelerate Finland's transition toward the circular economy
- **Anssi Paalanen,** Vice President of HorsePower, a service provided by Fortum (he has a master's degree in Physics Engineering from Helsinki University of Technology and a master's degree in Information and Service Management from Aalto University)

Trash2Cash: The Era of Augmented Intelligence

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ABSTRACT. *Augmented intelligence is superseding the concept of artificial intelligence as the denotation for the abbreviation of AI. We need systems to enhance human capabilities, rather than to replace us. In the digital world, management and exploitation of information has been a key factor in running businesses. Previously, data management was performed manually; later, with the help of computer tools; and, now, it is the time for AI to handle the data. In addition, AI can be utilized effectively in the application programming interface (API) economy as well as in building new services and solutions by exploiting the resources that companies currently have. In this article, we analyze the rising need of exploring big data and the upswing of platform economies and APIs. An extensive study on business models of start-ups developing AI APIs is carried out to explore whether AI is a key for setting up a successful entrepreneurial venture.*

KEYWORDS: *AI, artificial intelligence, augmented intelligence, application programming interface, economy, ecosystems, platforms, deep learning*

1 Introduction

Augmented intelligence has been promoted as a method to tackle the issue of rapid increase in the volume, variety, and velocity of data. The story of when and how data started its transformation to become "big" dates back more than 70 years. The growing rate in the volume of data became known as the "information explosion" in 1941 [1]. Since that moment, people in the information technology field have been concerned about the storage and further utilization of data. Specifically, what data should be stored, what information does that data contain, and how does the information relate to the previous knowledge?

The term *data* is typically used to depict all the observations that can be monitored and recorded from the surrounding world. Thus, even the data itself is a perceptually filtered view of the world, as demonstrated in Figure 1. The information is a further-filtered depiction of all the data that is relevant to the specific concept under the scope of the acting agent. Knowledge is largely based on the past information and learned models. On the other hand, the accumulated knowledge and the affecting values/norms are also applied to tune the perceptual and conceptual filters to find more meaningful data and, consequently, information from all the stimuli of the world. Furthermore, the agent can also generate new actions and test the feedback of the whole system [2]. In many ways, this depiction of data analysis is also valid for most machine learning algorithms, especially deep learning, discussed later in Section 4.2.2.

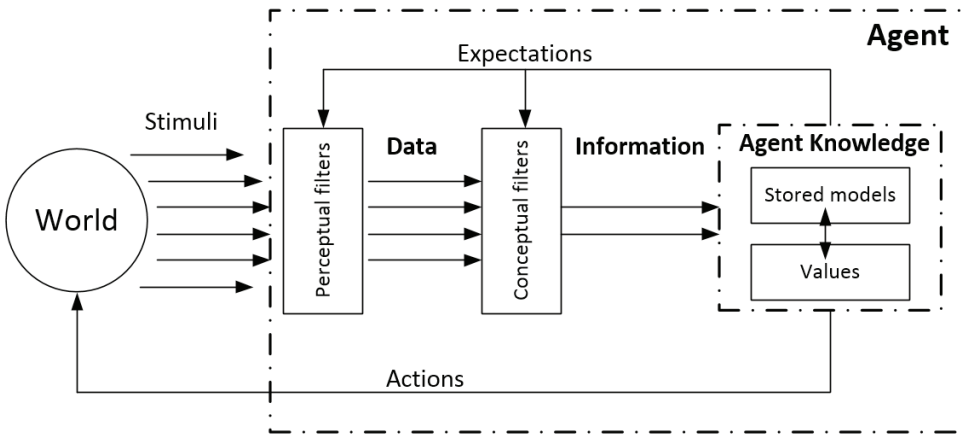

Fig. 1. *The relations between data, information, and knowledge from the perspective of the agent, adapted from [2].*

To understand how we have reached the point of implementing machines that can learn by themselves, we need to start from the history of data. An easy-to-

follow history of data evolution by Gil Press [3] is built up using the breakthrough publications reflecting on the significant steps in data treatment starting from 1944 to the beginning of the 21st century.

In the 1940s, the scientific community was already aware of the predicted increase in library volumes, which would have required a thrilling number of cataloguing staff, up to several thousand persons. The same trend still ruled the world in the 1960s. Derek de Solla Price, the author of *Science Since Babylon,* mentioned the "law of exponential increase," according to which each new scientific advance gives birth to a series of further advances. Already at that time, people had come to the conclusion that compression for safe and further easy-to-handle data is needed. A new data compressor "can be used with 'any' body of information to greatly reduce slow external storage requirements and to increase the rate of information transmission through a computer." The following two decades (1970s and 1980s) were held under the auspices of efficient storage system development and handling the obsolete data [3].

Approaching the end of the 1980s, scientists still wondered about the feasibility of saving all the data because the rate and volume of information flow overwhelmed the networks, storage devices, and retrieval systems, as well as the human capacity for comprehension. The solution was to build machines that can recognize and predict patterns in data without understanding the meaning of the patterns. Such machines were considered eventually to be fast enough to deal with large data streams in real time. This was thought to reduce the hazard of losing latent discoveries from burial into an immense database. These first ideas about the machine storage and analysis came out in 1990 [3].

The 1990s continued with the comparison of digital- and paper-based data storage, struggling to solve the issues related to capacities of machine memory and Internet traffic rates. This struggle gave birth to the first article in the digital library of the Association for Computing Machinery (ACM) to use the term *big data*. Many other major and minor problems have also been faced and reported, indicating significant development in this field [3].

In the beginning of the 2000s, another rapidly growing trend has arisen, referred to as "the democratization of data." In a nutshell, vast amounts of data are now created and stored by individuals [3]. Though some of this data might be considered trash, it needs to be stored and further analyzed. Most importantly, the significant milestones in data handling and analysis have lead us to the concept of information management. In the world of business, we would especially like to know all the relevant information prior to making decisions. The more conveniently the information is available, the better and faster decisions can be accomplished.

Nowadays, the world follows the trend of ubiquitous automatization boom.

While automatization touches on a number of everyday actions, decision-making efforts are still safeguarded by humans. Nevertheless, the idea of building human-like intelligence as autonomous trustworthy technology sounds tempting. This technology is commonly referred to as *artificial intelligence*. This two-word phrase often pops up in advertisements for a novel process/device/technique/service. If the product utilizes artificial intelligence, it becomes a hot cake immediately, even though the field of human decision making along with incredibly powerful computing resources is poorly understood. A question rises, how does human decision making coexist with autonomous artificially deducted decisions?

Interestingly, a new concept, called *augmented intelligence (AI)*. has emerged and is promoted, for example, by the information technology giant IBM. This form of AI aims to enhance human decision making rather than to replace it, which simplifies the situation, at least for now. However, it is difficult to define the differences between the services and products that use traditional artificial intelligence and augmented intelligence. To some extent, playing with the definitions is not meaningful, as most products and services are a mixture of many approaches. Nonetheless, some categorization for the terminology adopted in the field of artificial intelligence is discussed in Section 3.

The objective of this paper is to understand the business potential in augmented intelligence as well as the underlying value chain and related functions. A crucial aspect of this discussion involves application programming interfaces (APIs), tools for building up an application software that utilize internal or external data sources and create extra value from the data units. Next, in Section 2, we will introduce the overall concept of the API economy and the key players. Section 3 expands our knowledge of augmented intelligence and how it differs from the traditional artificial intelligence. The combination of augmented intelligence and APIs can bring up vast opportunities for *datapreneurs* (entrepreneurs dealing with data processing), which is the focus of Sections 4 and 5.

2 API Economy

This section depicts the concept of APIs and the related API economy. The rules and practices governing this economy need to be thoroughly understood by any successful venture in applying or developing APIs.

Application programming interfaces are software tools that enable interoperability or the sharing between websites and online services [4]. APIs are similar to user interfaces but have different users in mind. A useful metaphor is a wall socket. All electric appliances and electronic devices, from a vacuum cleaner to

a computer, require a wall socket to connect to the electricity supply. Without a wall socket, you would need to install hard-wired appliances into the walls of buildings. Thus, the wall socket is one form of user interface.

More than 2.8 billion people are connected to the Internet, and that number could swell to 5 billion in the near future. Data volume is projected to grow 50-fold over 15 years. Facing such a huge data and a market of 2.8 billion people, using the data content technology directly through a website is not an efficient model [5]. APIs have been fitted into this gap. An API can also provide the same functionality to third parties. Third parties can build apps around the data you provide, and mobile applications can use your API to create a better user experience. For example, you can remotely control the temperature of your apartment through an app that calls the API controlling your thermostat. When you are shopping online, an API is used to verify your credit card information. The list of examples and interconnections between APIs is enormous, creating the concept for the API economy. Furthermore, it has been stated that the API economy is an enabler for turning a business or organization into a platform [6] [7]. Figure 2 presents the typical composition of a platform from the viewpoint of this paper. In addition, it depicts the exchange of data and other value units between the platforms via APIs. Ideally, the end user only experiences the seamless operability of the service, unaware of the underlying activities and infrastructure.

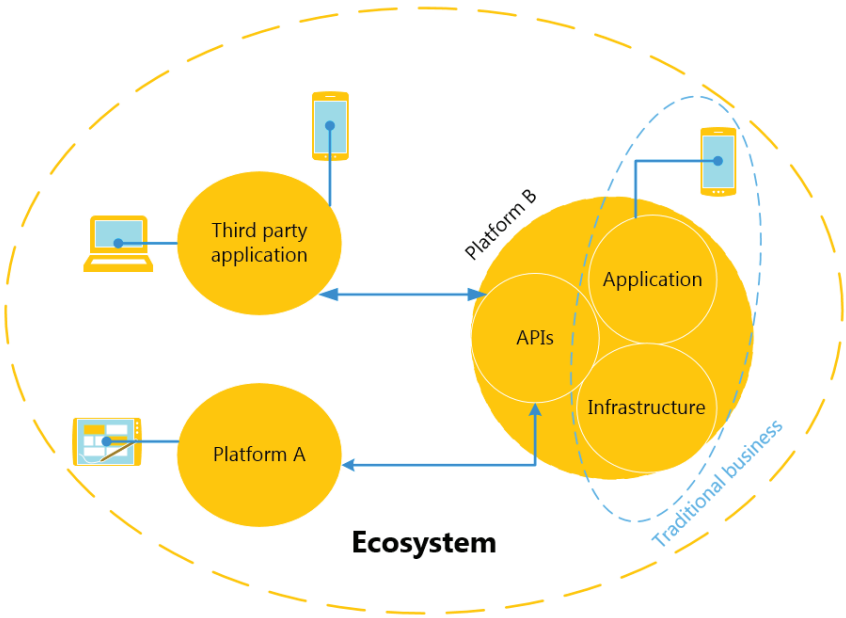

Fig. 2. *Example of an ecosystem, including involved platforms, services, and users.*

The role of the value chain for each API is crucial in defining the functionalities of the API economy and the platforms it entails. In the end, these functionalities determine the success of the API economy and the viability of businesses that are part of that ecosystem.

2.1 API Value Chain

API is not a direct channel to work with channel partners (developers) or end users. To understand the value chain of the API economy, it is important to figure out the functions of different partners involved in this game. The value chain of the API economy is shown in Fig. 3. The API value chain starts with business assets, such as useful information and some services or products that have some value and could be used by others. If these business assets contain no added value to the end user, the API will not succeed. The task of API providers is to expose these business assets to potential customers (developers) through designing an API that makes the best use of the business assets. The application developers, in turn, employ the API to create applications for the end users. Finally, the end users will use the applications according to their needs and give some value back to the developers, API designers, or business asset holders in a reverse flow of the chain. The value units flowing back in the value chain can be money directly or information that can turned into revenue later on, for example, in another API utilizing this information as a business asset. A prime example is targeted online advertising.

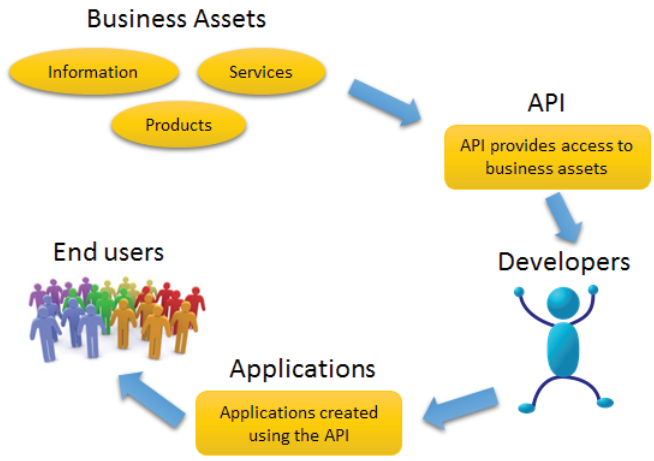

Fig. 3. *The value chain of the API economy, adapted from [5].*

The application developers are the kingmakers in this value chain. They need to design apps to meet the needs of the final users and try to reach them. API man-

agement is about understanding the needs of both the direct user (developer) and the indirect user (app user) of the API product. The links in the value chain and between the separate chains are important for the success of the API economy.

2.2 Business Model

The business models for APIs have been strongly developing. In 2005, there were just a few categories for API business models:

- free,
- developer pays,
- developer gets paid, and
- indirect [8].

"Free" means developers do not have to pay for the use of the API; examples for this model are public open-source APIs from governments. "Developer pays" means the developers have to pay to use the API. In this model, the underlying business assets need to have high enough value to the end user to make the business model sustainable for the developer. "Developer gets paid" means the developers get some revenue share by using the API. In this model, the apps created must have some value. "Indirect," on the other hand, relates to the value that is not measurable in money, at least instantly; instead the value is in raising awareness or increasing customer satisfaction that leads to increased returns later on, for example. An example of this indirect model is Facebook.

With the booming of APIs, these business models have developed into much larger collections in recent years. In 2013, the refined business models were considered as shown in Figure 4. The figure also lists example companies for each business model.

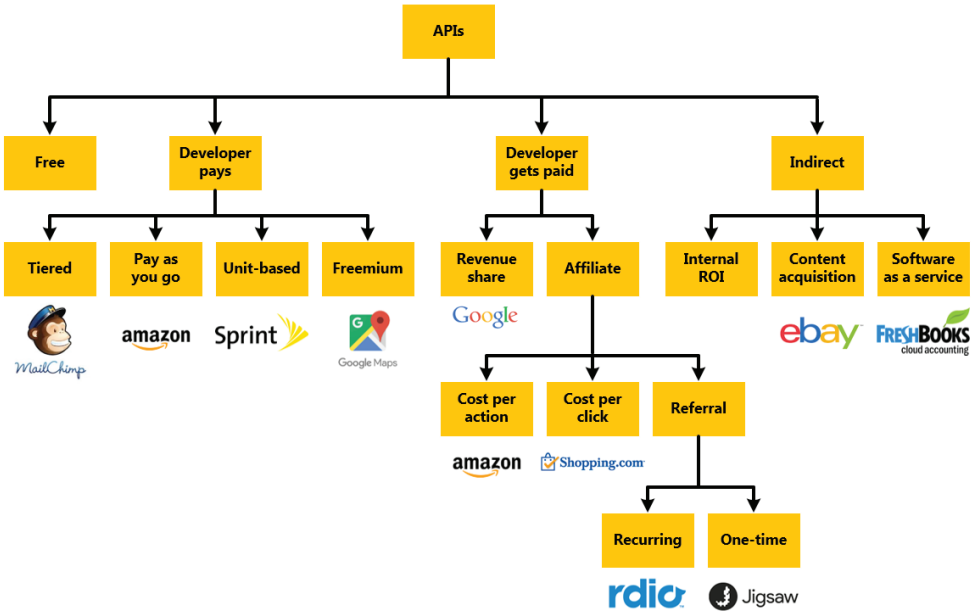

Fig. 4. *API business models in 2013, adapted from [8].*

Now that we have acquainted ourselves with the functionality of the APIs and the API economy, we can start to analyze the business creation in the emerging field of augmented intelligence. We will begin with an introduction to the overall concept.

3 Augmented Intelligence

Machine learning and artificial intelligence are significant fields in computer science that are emerging in order to replace human intelligence with capable robots. However, there is still a challenging question: Is machine intelligence taking the place of humans? On the other hand, the goal of augmented intelligence is to augment human brainpower with a strong business imperative. For example, the company IBM has developed technology and services with applied augmented intelligence and cognitive systems designed to increase human capability, expertise, and potential. Augmented intelligence cannot realistically reach consciousness or independent agency. It is embedded in the processes, systems, products, and services by which business and society function, all of which should remain under human control [9].

3.1 Artificial Intelligence vs. Augmented Intelligence

The artificial intelligence supporters believe in the future of computing where independent systems can be taught to substitute human cognitive functions. An example of this is Google's autonomous car, where the machine completely replaces human intervention and interaction. On the other hand, the augmented intelligence camp believes that information technology can augment and protect human contemplation, analysis, and planning, while leaving the human at the center of the human–computer interaction (HCI). The last two decades have demonstrated that artificial intelligence is improving fortunes, with the success of IBM'S Deep Blue computer, IBM's Watson, and Google's AlphaGo. These successes illustrated the excellence of computers over humans in fulfillment of a special kind of undertaking [10]. On the basis of artificial intelligence theorists, it is not only game-playing computer programs that are poised to wrest control of humans' lives.

Recently, Microsoft, Google, and Facebook have declared bot frameworks—software designed to automate tasks, such as setting up an appointment or surfing on the Internet. Modern bots apply artificial intelligence to process conversations, effectively substituting the human operators. Domino's bot for ordering pizzas and Taco Bell's bot for ordering food via Slack are recent examples of bots. The simplicity of the bot makes it possible to replace the rigid structure of the apps, improving usability and, in the end, increasing the total usage and revenue. Artificial intelligence-based solutions are appropriate in structured zones where the aims of the system are described, such as ordering a pizza, setting a meeting, and playing chess. However, artificial intelligence is not proper for conditions where goals and inputs are not well defined; it is here where augmented intelligence will continue to play an important role [11]. The combination of the human cognitive power and machine processing capabilities is depicted in Figure 5.

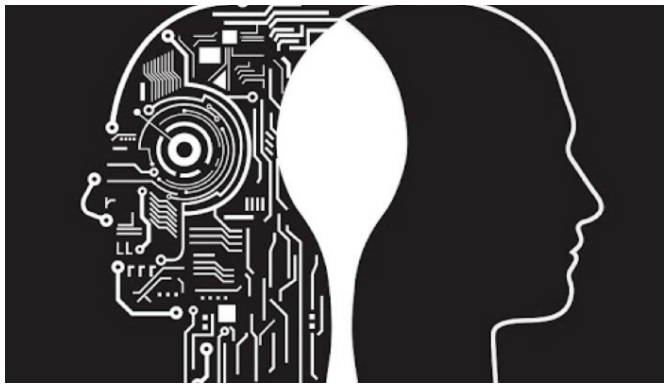

Fig. 5. *Combination of human and machine as augmented intelligence [12].*

The aim of augmented intelligence is to help humans mine through massive databases of information to extract the appropriate insights. These extracted insights aid humans to obtain new clues, conduct them to deeper question, and utilize their knowledge for decisions that lead to creative solutions. Thus, this approach closely relates to the data processing approach proposed in Figure 1.

3.2 Augmented Intelligence Works!

Augmented intelligence allows workers to play with the data and arrange and process it in a way that best allows them to make decisions on what to do next. It can be argued that systems that enhance human capabilities are more needed than systems that aspire to replicate the full scope of human intelligence. For example, Andrew Moore, Dean of Carnegie Mellon's School of Computer Science, estimated in 2015 [13] that 98 percent of augmented intelligence researchers are focused on engineering systems that can help people make better decisions rather than simulating human consciousness. In the worst case, at least according to science fiction, developing artificial intelligence systems that exceed human cognition and control may sow the seeds of humanity's eventual destruction. Augmented intelligence, on the other hand, can be harnessed to assist in reaching a better quality of life.

Researchers have also been working on embedding ethics on augmented intelligence systems, which means working with embedding social norms and values, similarly to Figure 1. For instance, in the case of cancer, IBM aided physicians to synthesize accessible data to improve patient care, while maintaining the integrity of other individuals. The system analyzes all the latest research and patient data and gives individualized treatment recommendations. Another example is in the legal area, where ROSS Intelligence developed a cognitive workbench to aid lawyers in analyzing legal issues and finding connections. Other benefits of such a system include the capability to be trained and get smarter over time and constantly grow the aim it serves.

In fact, the usage areas for augmented intelligence are vast. For instance, CogniToy dinosaur is an example of an augmented intelligence system exemplifying the potential of new interfaces for new products with new goals. Other valuable applications that focus on one particular task are provided by Alpha Modus in the financial sector, Staples in retail, and Medtronic in healthcare. In order to identify the economy of augmented intelligence APIs, we should first find out what are the capabilities and functionalities of augmented intelligence in different domains.

3.3 Augmented Intelligence in Action

The chess legend Garry Kasparov started to examine the interplay between man and computer after losing a game of chess to Deep Blue, IBM's chess playing machine. Inspired by the loss, Kasparov modularized a design for a new chess matches in order to characterize which grouping would collect best outcomes: humans, computers, or a combination of both. Many tournaments were played. Teams consisting of humans leveraging computer assistance consistently defeated all challengers, including the strongest "computer only" and "human only" teams. Kasparov reported a weird and unfolding finding [10]: The winner was not a grandmaster with a state-of-the-art computer but a pair of amateur American chess players using three computers at the same time. Teams with weaker human players getting benefit from faster computing mostly performed better than teams with stronger human players using downscaled computing. The combination of the speed and processing ability of a computer with a human's interpretive strengths resulted in better outcomes. This is augmented intelligence in its basic form. In other words, computational algorithms enable the meaningful combination of people and machines to put the end user in the optimal position to make an informed decision [14].

3.4 Augmenting the Growth

Augmented intelligence works and is applied already in a number of products and services. Next, we stipulate how augmented intelligence can enhance the growth of any business, by augmenting internal company analytics and processes.

Applying investigative analytical tasks has become more challenging because of the considerable increase in the collected data and increased complexity of the reasoning process itself. The straightforward aim of any analytic effort is to leverage information to superior business processes. This can include different techniques to recognize and follow multiple hypotheses and to collect documents to accredit correct hypotheses and delete the ones with no business value. Administration needs powerful means to perform tasks such as making decisions and collecting information from open environments, supporting them to adapt to actionable intelligence from continuously evolving data types.

An example service is a visual decision support system by Taste Analytics, which grants users access to the analytics loop, enabling users to recognize information that warrants attention. Accordingly, Taste Analytics provides a data-driven visual analytics platform to augment the ability of humans to mine

actionable insight from different unstructured textual data. It can be defined simply as algorithms that read and analyze textual data and specify the who, what, when, and where. A user subsequently uses this intelligence to distinguish the why and decide on suitable action [15].

Organizations can prevent some of the bear traps embedded in uncharted territory via augmented intelligence. Augmented intelligence offers multiple means to stay in control of a business as it grows, using strong tools to manage staff, money, and customer acceptability that help the company continue to grow. Four ways that augmented intelligence can support business growth follow.

Growing Headcount

One of the main ways in which a business expands is growing headcount. Many small businesses operate in high-trust networks. They comprise people with good understanding of the company's culture and goals. Bringing new staff on board carries a number of risks for those who are not part of this system, especially if the process is done swiftly. New staff may not be as familiar with the company's goals and culture. Bringing on board several new staff members might shift the culture toward a more low-trust network where there is a lot more supervision. Such a situation can be difficult for the existing staff who might not tolerate the change or become disaffected and leave, escalating the problem. In this case, the utilization of augmented intelligence can help to sustain the high-trust network. With augmentation, the new staff works in a structured environment in which their decisions and actions are visible and where they understand they will be held accountable for their contribution but can also receive real-time, valuable assistance [16]. Therefore, they can be encouraged to take responsibility for running their own areas of the business.

Decision-Making Support

Managers are the bottlenecks in expanding companies, in which a limited number of people are able to make decisions. This approach has been considered favorable due to the achieved consistency in running the business. However, the company where the CEO decides all the actions is a company where the CEO will be overburdened when the company grows, stagnating growth. In this case, using augmented intelligence to make educated suggestions to staff as well as to record their response means that humans and machines can work together to come up with best, or at least better, decisions and consequent solutions. As a result, there will be a decreased need to worry that people may miss important tasks or make decisions based on false data because of the visibility of the decision process. In many aspects, this is close to lean thinking, where the aim is to

reach high visibility in the production chain to remove unnecessary, wasteful processes.

An example of this type of decision process is found in the package delivery service UPS, which utilizes augmented intelligence application called ORION to shave time from drivers' routes. However, the company trusts its "boots on the ground," encouraging drivers to employ their own judgment in tandem with the system. Augmented intelligence is not only a substitute for human problem solving and decision making but has potential to augment it as well [16].

Customer Relations

Managing customer relations is another case that can rear its head as the business grows. In a small business, customers create powerful relationships with senior staff. However, as the business grows, and more customers are brought on board, the complications increase, and it becomes more difficult to ensure customer satisfaction and build meaningful relationships. Currently, such instruments as Salesforce's "Einstein" reveal how augmented intelligence can be utilized to handle customer relations to the highest standard continually. Furthermore, improvements in technology provide the possibility of monitoring all the interactions with customers across several platforms. Such data enables predicting and highlighting issues and helps staff to prioritize their time effectively. In other words, customers understand that their requirements are met at an early stage, which subsequently induces more satisfaction.

Resource Management

Keeping track of the revenue and material flow is a zone that can slide in a period of intense growth. When a business is small, it is relatively easy to keep track of the expected revenue and costs to see if the company is headed along the expected route. However, in a growing business, chaos can easily creep in. This can occur because of inability to invoice fast enough, inaccurate bills, or services that are no longer profitable. For instance, a consulting company may consent to sell with a fixed-price engagement requiring three business analysts but then find out that the company does not have the suitable staff available for the customer project at the required time frame. The business resource team might then send in staff who do not have the appropriate skill set, with the result that the engagement could end up costing more than the revenue it generates. Over time, these missteps can decrease profitability. Augmented intelligence can provide a much better idea of necessary resources required for the business that is in the pipeline and provide a dashboard view for the human resources team to pull together the best teams to deliver each engagement.

In the next section, we will expand our knowledge of augmented intelligence into AI APIs and the economy surrounding them.

4 AI API Economy

This section highlights the historical and potential future trends in the API economy with a detailed analysis of the progress of augmented intelligence APIs. We will introduce basic examples of the current offering of augmented intelligence APIs and how they can be applied in creating and accelerating businesses.

4.1 The Past

Human nature tends to resist change. This tendency is evident in the skepticism toward new business opportunities that emerge from possible future technological advancements and innovations. The progress of the Internet and the overall concept of the web does not escape this skepticism, especially after the IT bubble burst in the beginning of the millennium. For example, in 2007, an article targeted at IT professionals [17] focused on the potentials of Web 2.0, a concept referring to the then new website technology that provided richer, responsive user interfaces and easy content creation, enabling social media websites and blogs. However, a strong skepticism toward the added value of Web 2.0 was also reported, even though the related technologies were already becoming mainstream, in the form of MySpace and Facebook, as just two examples.

In a sense, augmented intelligence is also becoming mainstream with the help of the service providers and AI APIs, mostly related to the semantics and cognitive computing—that is, the interaction between machines and humans. The interaction is enhanced with AI APIs that, for example, provide natural language input processing and the resulting output. Thus, the user of a service employing the AI API does not have be to be an expert coder or specialist to use the service, and the service provider can outsource some of the key functions of the user interface.

The business around augmented intelligence APIs has been moderate in the past, but clear indicators for growth are already visible. According to the database provided by ProgrammableWeb, "known as the Web's de facto journal of the API economy" by its own depiction, the number of public APIs has surpassed 17,000 in 2017, averaging an annual increase of 2,000 APIs per year since 2013. It can be difficult to determine which API is actually an augmented intelligence API without knowing the actual operation under the hood. Nevertheless, some trends can be observed. For instance, after 2012, the amount of web APIs in the

most popular usage categories has been relatively balanced, with the exception of social, financial, and enterprise APIs, which have been on a faster growth path (see Figure 6). One could argue that augmented intelligence APIs, with their semantic characteristics, are beneficial at least in the social media services and e-commerce. To analyze this further, the next sections introduce the present offering of augmented intelligence APIs and utilization examples.

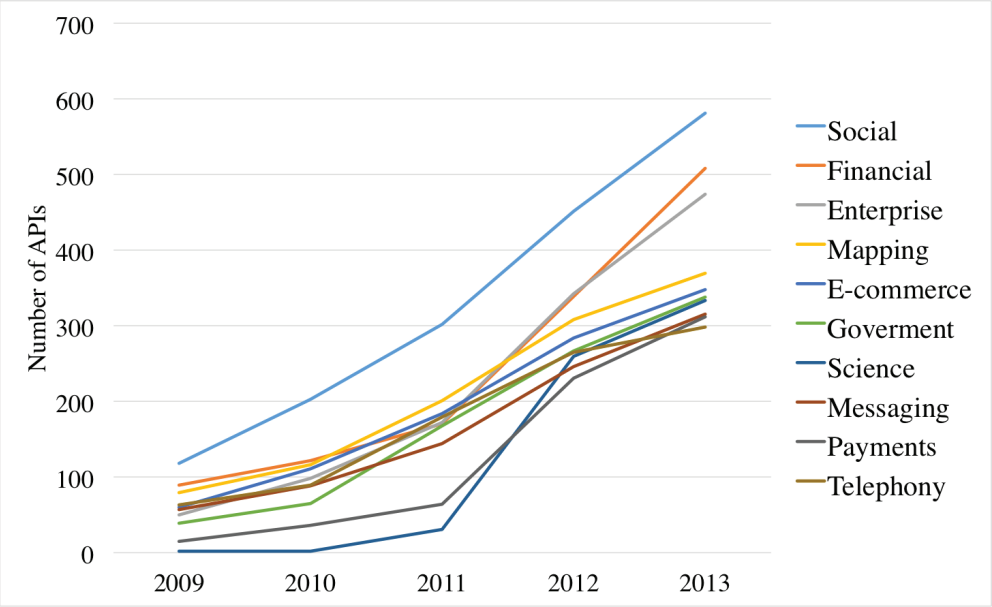

Fig. 6. *Number of reported web APIs by category from 2009 to 2013, adapted from [18].*

4.2 The Present: Forerunners in AI API Economy

This section presents the forerunners and enablers of the augmented intelligence API economy. These AI tool providers can be segmented into two groups: commercial and open-source AI platforms.

4.2.1 Commercial AI Platforms

An overview portraying some of the world's top rated AI API platforms in the commercial sector may shed light on how APIs can be successful [19]. Some of the extensively demanding areas where APIs are being used are speech and face recognition, predictive modeling, sentiment analysis, and pattern recognition.

The criteria on which APIs are ranked are

- popularity among users,
- potential in business practices,
- documentation,
- ease of use, and
- functionality.

IBM Watson

IBM Watson is the most popular commercial platform using machine learning, along with cognitive computing (see Figure 7). The IBM Watson Developer Cloud offers a collection of APIs that facilitate building applications using machine learning technologies including natural language processing, computer vision, and prediction. The IBM Watson APIs comprise speech-to-text and text-to-speech, trade-off analytics, personality insights, tone analyzer, and visual recognition.

Google Cloud Machine Learning

Google Machine Learning is a product family that provides easy-to-use APIs and gives access to the same technologies that are being used in Google products like Google Now, Google Photos, and voice recognition in Google Search. Developers can use the APIs to build applications capable of performing sentiment analysis, language translation, spam detection, document classification, image understanding, and more.

Microsoft Azure Machine Learning and Cognitive Services

Microsoft Azure Machine Learning is a platform designed for processing massive amounts of data and building predictive applications. The Microsoft Azure ML platform provides capabilities, such as natural language processing, recommendation engine, pattern recognition, computer vision, and predictive modeling. While the Microsoft Azure ML platform is rather new, the service has already gained significant popularity.

Azure Cognitive Services offers a suite of APIs for speech, vision, knowledge, and natural language processing for building apps with algorithms using only few lines of code. Services are aimed especially for organizations that do not want to work on training the machine learning models by themselves.

Amazon AI

Amazon AI offers variety of services, platforms, and frameworks for natural language understanding, automatic speech recognition, visual search and image recognition, text-to-speech and machine learning.

The Amazon Machine Learning service makes it possible to build more powerful intelligent applications that feature machine learning capabilities, such as pattern recognition and prediction. Developers can use Amazon ML APIs to build applications that feature fraud detection, content personalization, document classification, customer churn prediction, and more. The Amazon ML developer site features a large selection of SDKs and client libraries, a forum, an API reference section, machine learning concepts section, and more. Amazon does provide visualization tools and wizards that help users with the process of creating machine learning models.

Table 1 summarizes the key characteristics of the presented commercial AI platforms. The amount of interest toward these platforms is revealed in Figure 7. All of the platforms are clearly gaining recognition, while IBM Watson remains in its own league among the commercial solutions.

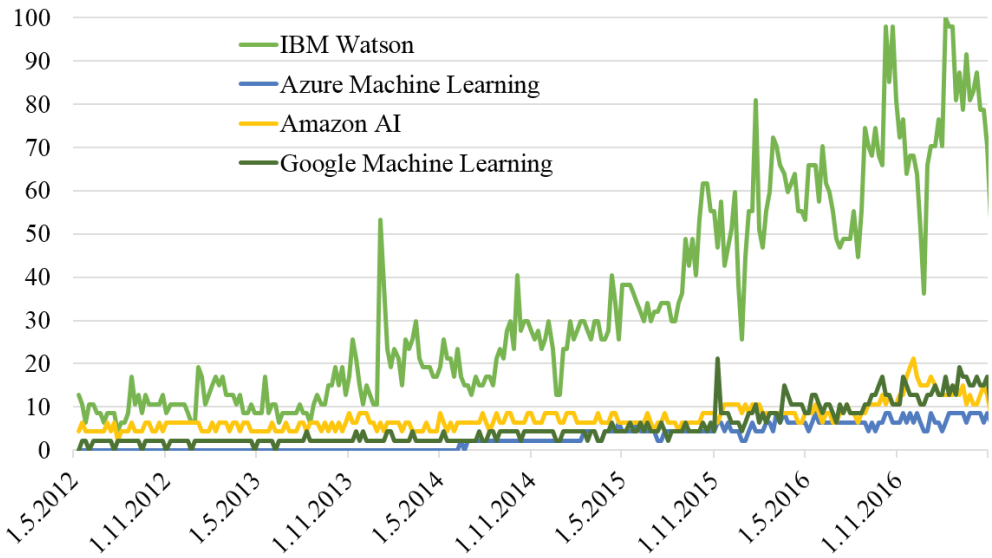

Fig. 7. *Comparison of relative Google search interest of different commercial AI API platforms over time.*

Table 1. *A sample list of commercial AI APIs.*

Company	Language Understanding APIs	Speech APIs	Image and Video APIs	Machine Learning APIs	Other APIs
IBM	Conversation, Document Conversion, Language Translator, Natural Language Classifier, Natural Language Understanding, Personality Insights, Retrieve and Rank, Tone Analyzer	Speech-to-Text, Text-to-Speech	Visual Recognition	-	Discovery, Discovery News, Tradeoff Analytics
Amazon	Amazon Lex	Amazon Polly, Amazon lex	Amazon Rekognition	Amazon Machine Learning	-
Microsoft	Bing Spell Check API, Language Understanding Intelligent Service, Linguistic Analysis API, Text Analytics API, Translator API, Web Language Model API	Bing Speech API, Custom Speech Service, Speaker Recognition API	Computer Vision API, Content Moderator, Emotion API, Face API, Video API	Azure Machine Learning	Academic Knowledge API, Entity Linking Intelligence Service, Knowledge Exploration Service, QnA Maker, Recommendations API, Bing Autosuggest API, Bing Image Search API, Bing News API, Bing Video Search API, Bing Web Search API
Google	Google Natural Language API, Google Cloud Translation API	Google Cloud Speech API	Google Cloud Video Intelligence API, Google Cloud Vision API	Google Cloud Prediction API	Google Cloud Jobs API

4.2.2 Open-Source AI Platforms

Common open-source platforms can be applied in creating services and business around the augmented intelligence concept. As there is a huge variety of open-source AI platforms available, ranging in size, usability, and core technology, we must narrow down our analysis. The specific focus is in the most applied open-source frameworks that are based on deep learning technology.

Deep learning is a branch of AI. It is machine learning that utilizes neural networks, a set of algorithms designed to recognize patterns in a loosely similar manner to a human brain. In general, deep learning frameworks are more specialized compared to general machine-learning frameworks. Rather than a service, deep learning frameworks can be seen as libraries of different deep

learning tools. The availability of large training data sets and the efficient use of graphical processing have made deep learning increasingly popular in recent years. Deep learning frameworks provide "state-of-the-art in speech recognition, visual object recognition, object detection and many other domains such as drug discovery and genomics" [20]. Figure 8 provides a commonly used depiction of the relations between artificial intelligence, machine learning, and deep learning.

As we can see from Table 2, almost all commercial players that have their own commercial proprietary solutions (covered in Table 1) are also developing open-source frameworks, mostly for their internal development needs.

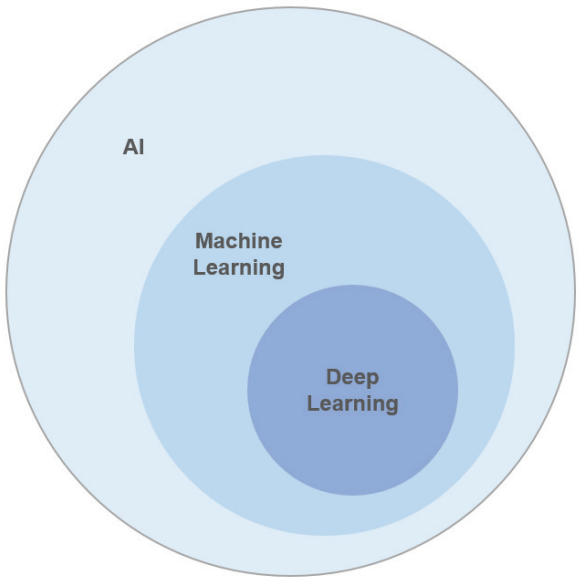

Fig. 8. *The relation between AI, machine learning, and deep learning, adapted from [21].*

Table 2. *A list of the most popular open-source deep learning frameworks [22].*

Framework	Developer	Initial release	Other information
Tensorflow	Google Brain team	2015	Most popular deep learning framework. Originally developed for internal use at Google.
Caffe	Berkeley Vision and Learning Center (BVLC)	2014	Expected to be overtaken by Caffe2.
The Microsoft Cognitive Toolkit (CNTK)	Microsoft Research	2015	Has been used by Microsoft for developing Skype, Cortana, Bing, and Xbox.
MXNet	Distributed (Deep) Machine Learning Community (DMLC)	2015	Used by Amazon as its deep learning framework at Amazon Web Services (AWS).
Torch	Ronan Collobert, Koray Kavukcuoglu, Clement Farabet	2002	Main contributors are Facebook, Twitter, and Nvidia.
Deeplearning4j (DL4J)	Skymind	2014	Integrates with multiple cloud services (AWS, Google Cloud, Hadoop, etc.) instead of being optimized to a specific one.
Theano	Université de Montréal	2008	Networks can be specified symbolically similar to Tensorflow and CNTK.
Caffe2	Facebook Open Source	2017	More focused on modularity and large-scale mobile deployment than the original Caffe. Will be used by Facebook as its primary deep learning framework

How to choose which framework to use? In the end, no single perfect deep learning network exists that would solve all your business problems. The dilemma with open-source frameworks is to determine which deep learning approach is best fit for your purpose and data at hand. On the other hand, what will be your exit strategy if you choose to go with a commercial approach?

According to Werner Vogels (CTO at Amazon.com), there are three major factors for developers, data scientists, and researchers to consider when selecting a deep learning framework:

1. Ability to scale up the processing (GPU) capability to train larger, more sophisticated models with bigger, more sophisticated data.
2. Development speed and programmability with languages that are already familiar to developers.
3. Portability to run on a wide range of platforms and devices with varying computing power and reliability of networking [23].

Out of the open-source AI platforms, only Tensorflow has been comparable to the commercial IBM Watson in the level of utilization. Recently, its popular-

ity has surpassed IBM Watson, at least according to Google Trends (see Figure 9).

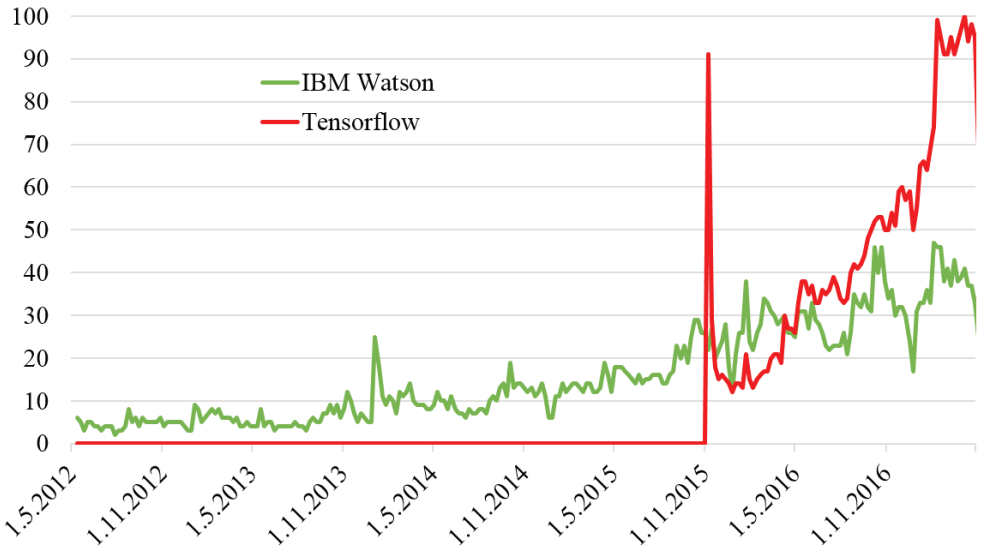

Fig. 9. *The relative popularity of open-source Tensorflow over the commercial IBM Watson in recent years according to Google Trends.*

4.3 The Future

As demonstrated in Section 4.2, IBM is a strong supporter of augmented intelligence. Thus, a question can be raised: Does IBM promote augmented intelligence instead of artificial intelligence because artificial intelligence seems abstract even though it has been applied in a variety of forms already for years, if not decades? For example, an article by M.A. Laughton [24] estimates that even prior to 1997 there were more than 400 publications on the applications of artificial intelligence, and this was only in the area of power systems. Nevertheless, perhaps augmented intelligence as a concept seems more adaptable and approachable than the science fiction-based AI that is always depicted as wresting control from humans. Speaking of augmented intelligence can, thus, increase the user base (developers) of AI APIs, accelerating the growth of the AI API economy.

AI APIs are definitely coming more into practice. However, currently, the actual adoption ratio is still perhaps lower than considered for a "Semantic Web" (see Figure 10). Nonetheless, the number of mashups, a concept closely related to the Semantic Web, has been rising steadily. This indicates that the

basic supportive structure of the Semantic Web (and AI API economy) is foundationally strong, and the communication between different APIs is business as usual.

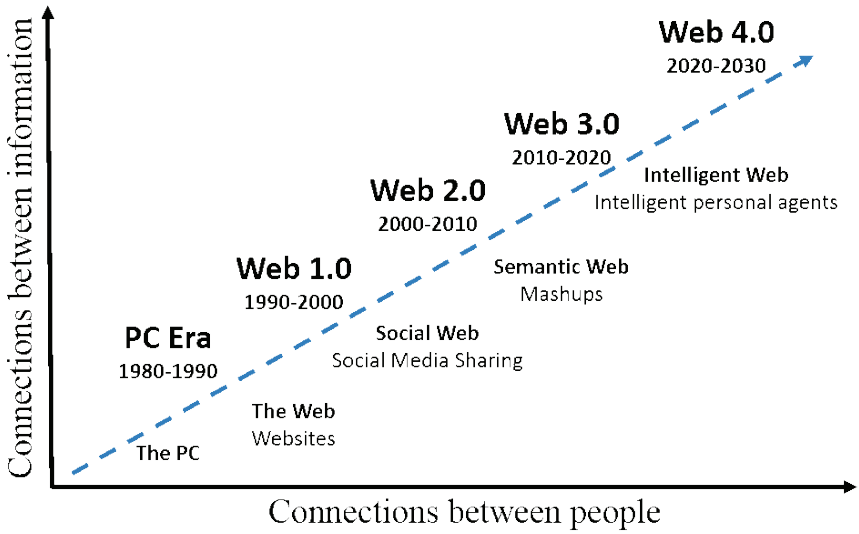

Fig. 10. *The timeline of historical and projected web development and examples of usage, adapted from [25] [26].*

A careful analysis of Figure 10 reveals that connections between all the information and all the people are increasing with each stage of the web development, and these connections are presumed to continue to expand in the future. This necessitates a smoothly functioning API economy in general. The next conceived stage of web development is the Intelligent Web with intelligent personal agents. As these agents are by definition personal and intelligent, the utilization rate of augmented intelligence will surely surge. Examples of such personal assistants are already a part of our everyday lives though their use is still far from frictionless, as our sometimes amusing encounters with Siri and Cortana can testify.

Another supportive indicator for the prospects of augmented intelligence can be found in Gartner's hype cycle for emerging technologies. Figure 11 indicates that within the next two to ten years, numerous AI-based technologies will be emerging in our daily lives.

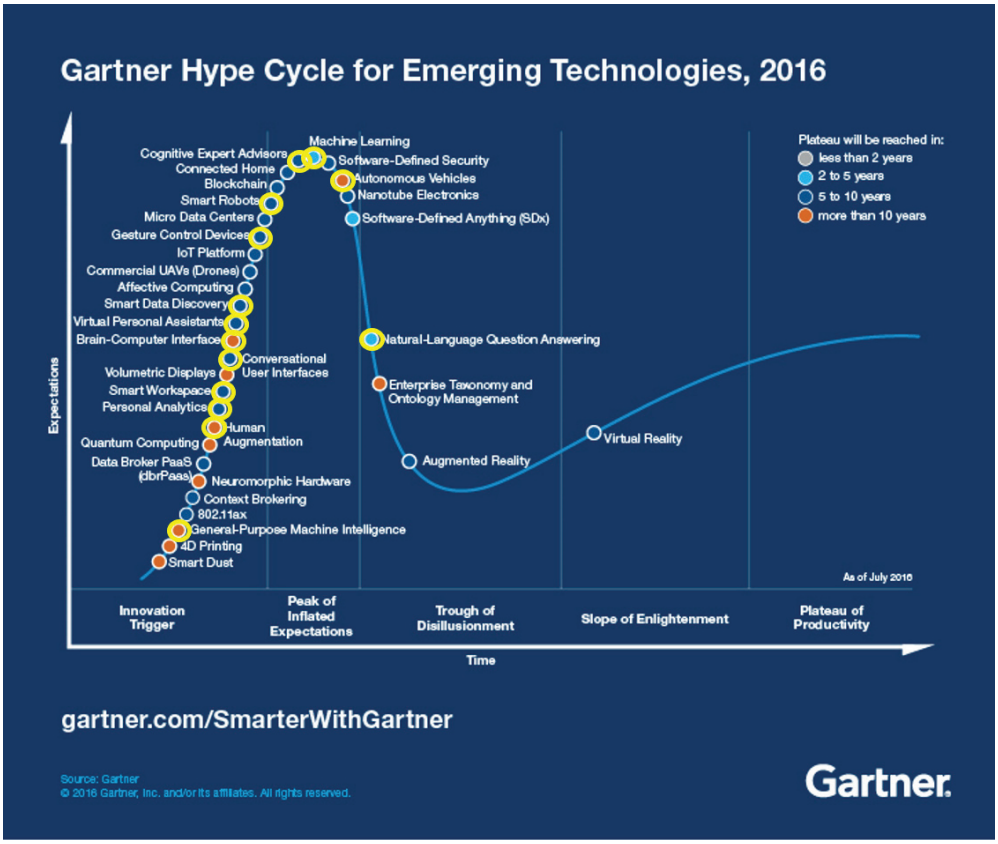

Fig. 11. *Hype cycle of emerging technologies with AI-based technologies circled in yellow. Underlying figure by Gartner, Inc. [27].*

The next section highlights the potential of the augmented intelligence APIs for entrepreneurs using examples of successful start-ups in the field.

5 Entrepreneurial Potential of AI API Platforms

The outburst in AI APIs opens a whole new world of capabilities to software developers and entrepreneurs. The machine learning and other AI technologies are key factors in filling the rising need of intelligent decision making across all industries and business platforms. A software developer could build AI platforms, given that it could afford to spend a few years and assign a couple data scientists to work hard on the projects. Or a developer could access AI engines like IBM's Watson or Google's TensorFlow as a service to take advantage one of the most advanced computer science outcomes through an API call [28].

5.1 AI, API, and the Beginning of a New Age in Computer Science

In this era of AI APIs, the choice for developers and entrepreneurs becomes clear. They can be software innovators, integrators, or designers.

- Innovators are working on research and development, making new algorithms that have not yet been taken into practice and improving the capabilities of those that are already available.
- Designers make new products, solutions, and applications, using powerful technologies like machine learning and other AI services. These technologies are easily accessible through open APIs to discover new opportunities, build new solutions, and solve problems in efficient ways.
- Integrators take currently available AI resources and convert them into new products. Their role is to deal with the process of implementing the designs that bring innovations together. They do not design the algorithms or products; rather, they make them work.

It is important for academia, businesses, and developers to understand the distinction between these three very different types of software developers when it comes to start a new venture in an AI-related field. They represent three different skill sets and approaches to the business of software development in different ways. Today's world of business and software development requires all of them, and companies need to be able to tell them apart and pick the right tool for the right job.

When it comes to entrepreneurial ventures, these factors play a major role in launching a new start-up and composing the winning team.

5.2 Case Study: AI-Based Start-ups

Elevated investor interest in AI start-ups can be attributed to recent advances in machine learning algorithms, mainly in deep learning technology. Table 3 presents some successful AI-based start-ups launched in recent years in different fields of business and technology [29]. The start-ups represent a few examples on how AI-based entrepreneurial firms have emerged in different sectors and countries. At the moment, healthcare is probably the hottest area of investment compared to other industry-specific applications of artificial intelligence due to large databases and sheer business potential. The large business potential in healthcare is highly impacted by outdated procedures, including slow, manual analytical steps that are prone to human errors. Thus, augmenting the analysis and decision making clearly has a positive impact in healthcare.

From 2012 to 2016, funding for AI-based start-ups escalated nearly 1,000 percent. In 2012, the funding was around $500 million; in 2016, it reached $5

billion USD [30]. The increased demand for intelligent decision making in industries and open sourcing of AI platforms have lead investors more into the field of augmented intelligence and allied sectors.

Table 3. *A sample list of start-ups in different fields of AI.*

Field	Startups	Products/ Services	Funding/Investors
1. Computer Vision Start-ups in this field are using deep learning for image recognition, analytics, and classification.	Terraloupe, Germany	Aerial image analytics	Bayern Kapital
	Calrifai, USA	Visual recognition	Google Ventures, Lux Capital, and NVidia
2. Speech Analytics/ Conversational Interface	Mobvoi, China	Smart watch includes speech recognition, text-to-speech conversion, and semantic analysis	Google
	VivLabs, USA	Speech recognition AI assistance for phones	Horizons Ventures and Pritzker Group Venture Capital
3. Core AI Start-ups in this area are developing algorithms that can be applied across multiple industries like finance, healthcare, and e-commerce.	LeapMind, Japan	Object recognition, arithmetic compression.	Archetype Ventures, ITOCHU Technology Ventures, and Visionnaire Ventures
	Teradeep, USA	Accelerates deep learning via field programmable gate arrays (FPGAs)	Xilinx Technology Growth Fund
4. Auto and Robotics	Netradyne, India	Driver safety platform named Driveri	Reliance Industries
	Comma.ai, USA	Auto tech	Andreessen Horowitz
	Turing Robot, China	Voice technologies	Alpha Animation & Cultur
5. Healthcare	Insilico, USA	Drug discovery	Deep Knowledge Ventures
	Pathway Genomics, USA	Personalized care based on individual genomics	IBM
	Butterfly Network, USA	Medical imaging and diagnostics	Aeris Capital
6. E-Commerce	Reflektion, USA	Real-time customer preferencing	Intel Capital, Battery Venture
	ViSenze, Singapore	Search categorization with visual discovery	Rakuten Ventures, Enspire Capital, Phillip Private Equity
	Staqu, India	Visual recommendation	Indian angel network

6 Conclusions

This paper introduced the concept of augmented intelligence (AI), which enhances human decision making rather than replacing it with artificial intelligence. In augmented intelligence, the user is embedded in the decision-making loop, and the user can leverage on the computational power of modern PCs utilizing state-of-the-art machine learning algorithms and approaches, such as deep learning. Due to the embedded human-computer interaction (HCI), certain key application areas are especially considered as augmented intelligence. These application areas are particularly related to semantics and cognitive processes, including pattern or speech recognition.

The business potential for AI-based products is vast. For example, in any industry, the most successful companies need not only to combine existing ideas and strategies into a novel package but also to master the user experience (UX). AI enables an intuitive, personalized experience for each user. Furthermore, augmented intelligence can help to support the growth of any company with smart tools designed to improve internal analytics and processes. At the moment, the number of such tools and other AI services are scarce but increasing at a fast rate due to the easy-to-use, interlinked AI platforms. The platforms provide numerous application programming interfaces (APIs), which can be combined to create novel, fast-scaling end-user applications and other services. In addition, various monetization models in the API economy enable a large spectrum of business models.

Any new venture building AI-based products and services needs to consider the pros and cons of the multiple open-source AI libraries and commercial equivalents. The commercial platforms are typically faster to adopt and to scale than open-source platforms that are commonly plain libraries without the supportive server infrastructure. However, in the long run, an open-source approach can yield to more adaptability, which is crucial for growing start-ups. Furthermore, the whole field is rapidly evolving due to the increased computing and storage capacity and more advanced interconnections between the different services and APIs. Thus, the companies involved in this field need to evolve constantly to avoid becoming obsolete. A key part of this evolution is in understanding the overall ecosystem around the API economy and augmented intelligence. Companies should be positioned to allow the best utilization of their competencies because of the tense competition in the field accelerated by rapidly rising funding.

Experts in the field of AI and machine learning believe that, in the not-so-distant future, machines will have reached some dimensions of human intelligence. In fact, many knowledge-based jobs are already being augmented with AIs, and it

is estimated that one quarter of all job-based tasks could be automated by 2020. On the other hand, debates and controversies are underway on the possible side effects of unemployment and threat to humankind due to the escalation of AI in recent years. The same shades of opinions and disagreements were there when computers and, later, the Internet came into our daily lives. Today, it seems that the world could not exist without computers and the Internet. With the explosion of population and data as well as the increased need of super-fast decision making, augmented intelligence and associated technologies are, without doubt, the present and future next to the line of computers and the Internet.

The era of augmented intelligence is now! Don't miss it.

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Appendices

1. The Bit Bang People

FACILITATORS

Ormala, Erkki – Professor at the Department of Management and International Business. He has a PhD in Engineering from Helsinki University of Technology. He is a former Vice President of Nokia Corp. Ormala has chaired the assessment of the EU R&D Framework Program and the association of the European Digital Industry, DIGITALEUROPE. He is a member of a European Commission initiated high level advisory board on the future of the European media.

Neuvo, Yrjö – Research Director. He has a PhD in Electrical Engineering from Cornell University. He is a former CTO of Nokia Corp. He has worked as a National Research Professor at Academy of Finland and a visiting professor at University of California, Santa Barbara. During his academic career he produced 30 doctors. Over the years he has been actively promoting industry-academia cooperation. He has been awarded 4 honorary doctorates.

Kuikka, Meri – Social media researcher, doctoral candidate in Information Systems Science. MSc (Information Service Management) and BSc (Business Technology) from Aalto School of Business. Current research topics include social media strategy for organizational use and challenges related to social media use in organizations.

TUTORS

Moktan, Gautam Raj – Nepali, MSc. A PhD student at the Department of Communications and Networking, Aalto School of Electrical Engineering.
Research topic: Resource allocation in Internet data transport.
Other interests: Photography, music, community activities.

Noorizadeh, Abdollah – Iranian, MSc. A PhD student at the Department of Civil Engineering, Aalto School of Engineering.
Research topic: High-performance construction.
Other interests: Running, reading.

Nykänen, Jussi – Finnish, MSc. A PhD student at the Department of Information and Service Management, Aalto School of Business.
Research topic: Consumer switching on mobile platforms.
Other interests: Football, movies, music, societal issues.

Rodriguez, Tania – Mexican, MA. A PhD student at the Department of Visual Communication Design, Aalto School of Arts, Design, Architecture.
Research topic: Language learning by design.
Other interests: Cooking, reading, coding, learning to play piano, puzzles, family time.

PARTICIPANTS

Aleksandrova, Irina – Russian, MSc. A PhD student at the Department of Inorganic Chemistry, Aalto School of Chemical Technology.
Research topic: Thermoelectric materials based on earth-abundant sulfides.
Other interests: Hiking, horse riding, gym exercises, drawing.

Alimohammadisagvand, Behrang – Iranian, MSc. A PhD student at the Department of Mechanical Engineering, Aalto School of Engineering.
Research topic: Influence of demand response actions on energy consumption and energy cost for residential houses in Finland.
Other interests: Reading, sports, watching movies.

Bica, Marian – Romanian, MSc. A PhD student at the Department of Signal Processing and Acoustics, Aalto School of Electrical Engineering.
Research topic: Agile multicarrier radars and spectrum sharing with communication systems.
Other interests: Gym, photography, technology.

Bozorg chenani, Sanaz – Iranian, MSc. A PhD student at the Department of Built Environment, Aalto School of Engineering.
Research topic: Real time intelligent road lighting for saving energy without compromising traffic safety.
Other interests: Photography, gardening, swimming, mediation.

Fang, Wenwen – Chinese, MSc. A PhD student at the Department of Materials Science and Engineering, Aalto School of Chemical Technology.
Research topic: Cellulose based nanocomposites.
Other interests: Hand crafting, baking.

Ghobakhlou, Mojtaba – Iranian, MSc. A PhD student at the Department of Civil Engineering, Aalto School of Engineering.
Research topic: Evaluation of C-pile behavior.
Other interests: Fishing, running, cycling.

Ginchev, Todor – Bulgarian, MSc. A PhD student at the Department of COMNET, Aalto School of Electrical Engineering.
Research topic: Machine learning applied to IoT for healthcare purpose.
Other interests: Sport: ice skating and cross-country skiing.

Guo, Jiaqi – Chinese, MSc. A PhD student at the Department of Forest Products Technology, Aalto School of Chemical Technology.
Research topic: Chemical modification of nanocellulose towards functional materials.
Other interests: Running, skating, hiking.

Julin, Arttu – Finnish, MSc. A PhD student at the Department of Built Environment, Aalto School of Engineering.
Research topic: Applications of virtual reality and 3D models for built environment.
Other interests: Tennis, skiing, gaming, photography.

Li, Yongzhe – Chinese, MSc. A PhD student at the Department of Signal Processing and Acoustics, Aalto School of Electrical Engineering.
Research topic: Joint transmission and receive filter design with applications to array signal processing and communications.
Other interests: Basketball.

López González, Diego – Spanish, MSc. A PhD student at the Department of Applied Physics, Aalto School of Science.
Research topic: Electric field control of magnetism in multiferroic heterostructures.
Other interests: Reading, meeting with friends, traveling.

Lähde, Elisa – Finnish, MSc. A PhD student at the Department of Architecture, Aalto School of Arts, Design and Architecture.
Research topic: Urban hydrology as a part of local green infrastructure systems – ecosystem service optimized stormwater management structures.
Other interests: Yoga, trekking and climbing.

Marttila, Mari – Finnish, MSSc. A PhD student at the Department of Political and Economic Studies (UH) / HIIT, Aalto School of Science.
Research topic: Digital inequality and the functioning of democracy at the age of digitalization.
Other interests: Finnish baseball, biking.

Mirzaeifar, Saeed – Iranian, MSc. A PhD student at the Department of Civil Engineering and Construction, Aalto School of Engineering.
Research topic: Cross-domain analysis of system of systems in build environment.
Other interests: Electronic gaming, playing volleyball.

Mokammel, Faisal – Bangladeshi, MSc. A PhD student at the Department of Mechanical Engineering, Aalto School of Engineering.
Research topic: Computational analysis of requirements in early design phase.
Other interests: Amateur radio operator, hiking, camping.

Nair, Devi – Indian, MSc. A PhD student at the Department of Electrical Engineering and Automation, Aalto School of Electrical Engineering.
Research topic: Segregation of machine core losses through inverse thermal modelling and calorimetry.
Other interests: Photography, literature, badminton, movies, cooking.

Nicoletti Dziobczenski, Paulo Roberto – Brazilian, MSc. A PhD student at the Department of Design, Aalto School of Arts, Design and Architecture.
Research topic: The graphic design profession: what are the skills sought by these professionals from companies.
Other interests: Running, football, tv shows.

Sathyan, Sabin – Indian, MSc. A PhD student at the Department of Electrical Engineering and Automation, Aalto School of Electrical Engineering.
Research topic: Open source based magneto-vibro-acoustic computations of electrical machines.
Other interests: Cooking, music, guitar, movies, nature, trekking, boxing.

Savage, Paul – Finnish-Canadian, Master of Culture & Arts. A PhD student at the Department of Management & Organization, Aalto School of Business.
Research topic: Discourse and narrative on emerging organization.
Other interests: Motorcycling, tailoring, theatre.

Singh, Bikramjit – Indian, MSc. A PhD student at the Department of Communications and Networking, Aalto School of Electrical Engineering.
Research topic: Game-theoretic inter-operator spectrum sharing.
Other interests: Dirt biking, hiking, skydiving.

Tukia, Toni – Finnish, MSc. A PhD student at the Department of Electrical Engineering and Automation, Aalto School of Electrical Engineering.
Research topic: Energy and power balance of office buildings and effect of renewable generation.
Other interests: Entrepreneuring, outdooring, golf.

Uimonen, Semen – Russian, MSc. A PhD student at the Department of Electrical Engineering and Automation, Aalto School of Electrical Engineering.
Research topic: Energy balance in buildings and the role of people in it.
Other interests: Basketball, markets, mountain bike.

You, Xiang – Chinese, MSc. A PhD student at the Department of Forest Products Technology, Aalto School of Chemical Technology.
Research topic: AVAP fractionation of woody and non-woody biomass.
Other interests: Playing piano.

2. Guest Lecturers

- Tapani Alasaarela, BroadBit Batteries
- William Brace, VTT Technical Research Centre of Finland
- Kjell Forsen, Vaisala
- Jussi Hinkkanen, Fuzu
- Ari Huczkowski, Espoo Innovation Garden
- Urho Ilmonen, FACT Law
- Teemu Kautonen, Aalto University
- Juha Kokkonen, Canatu
- Matti Kähkönen, Metso
- Pasi Laine, Valmet
- Aija Leiponen, Cornell
- Erkki Liikanen, Bank of Finland
- Petra Lundström, Fortum
- Leena Mörttinen, The Finnish Family Firms Association
- Tero Ojanperä, Vision+
- Jyrki Ovaska, UPM
- Petri Peltonen, Ministry of Economic Affairs and Employment
- Samppa Ruohtula, IKI-Kiuas
- Jukka Salmikuukka, Kone
- Martti Savelainen, Sappi
- Varun Singh, callstats.io
- Pekka Soini, Tekes
- Anssi Vanjoki, Lappeenranta University of Technology
- Olli Vuola, Aalto Ventures Program

3. Course Literature

Bit Bang – Rays to the Future. Yrjö Neuvo & Sami Ylönen (eds.) 2009. Helsinki University of Technology.

Bit Bang 2 – Energising Innovation, Innovating Energy. Yrjö Neuvo & Sami Ylönen (eds.) 2010. Aalto University.

Bit Bang 3 – Entrepreneurship and Services. Yrjö Neuvo & Sami Ylönen (eds.) 2011. Aalto University.

Bit Bang 4 –Future or Internet. Yrjö Neuvo & Elina Karvonen (eds.) 2012. Aalto University.

Bit Bang 5 – Changing Global Landscapes – Role of Policy Making and Innovation Capability. Yrjö Neuvo, Erkki Ormala & Elina Karvonen (eds.) 2013. Aalto University.

Bit Bang 6 – Future of Media. Yrjö Neuvo, Erkki Ormala & Meri Kuikka (eds.) 2014. Aalto University.

Bit Bang 7 – Future of Energy. Yrjö Neuvo, Erkki Ormala & Meri Kuikka (eds.) 2015. Aalto University.

Bit Bang 8 – Digitalization. Yrjö Neuvo, Erkki Ormala & Meri Kuikka (eds.) 2016. Aalto University.

Enterprise and Small Business: Principles, Practice and Policy. Sara Carter 2012. Pearson.

4. Study Program in New York and Boston

Monday, January 30th, 2017

8:30	Kick-off meeting
10:30	Consulate General of Finland, Hanna Valkonen
13:15	Google, Johanna Wahlroos
16:00	Idean, Ville Kurki / Laura Immonen-Beatty

Tuesday, January 31st, 2017

10:00	Startup Health, Anne Dordai, Jaime Haak
13:30	Urban Future Lab, Joe Silver

Wednesday, February 1st, 2017

9:00	Nokia Bell Labs, Barbi Walker

Thursday, February 2nd, 2017

17:00	IBM augmented intelligence workshop, Armen Pischdotchian

Friday, February 3rd, 2017

10:00	MIT Museum
13:00	Beaver Works, John Vivilecchia, Bob Gabel
15:30	Bengt Holmström, Bengt Holmström
19:00	Closing dinner

5. Study Tour Reports

Monday, January 30th, 2017

Consulate General of Finland

The East Coast trip has started with an early Monday visit to the Consulate General of Finland in New York. Two friendly representatives, **Anna Yletyinen** and **Silve Parvinen**, met us at the lobby and escorted our team to the conference hall. Anna works as a deputy consul general and Silve is an advisor for economic and commercial affairs.

The fruitful discussion lasted for around 1.5 hours within which we learned the missions of the Finnish Consulate in the USA, such as trade and promotion of Finnish businesses in general and startups in particular. They are particularly interested in promotion of ICT, digitalization and HealthTech fields.

Anna and Silve listed several "promotion tools" they are applying: invitation of American investors in Finland (i), cooperation with Finpro (ii) and investment promotion events in the US (iii). The areas of their expertise include advisory and promotion support for Finnish companies willing to "settle down" in the US. Furthermore, they highlighted the fact that their services are mostly free of charge. However, they are only interested in providing help for companies that already have revenue in Finland (meaning that they can be competitive in the American market). On the other hand, it is rather easy to grow the Finnish company big in the US because "if you work under the Scandinavian flag, you are highly appreciated".

The Finnish Consulate is planning to run a project in New York named the Nordic Innovation House in collaboration with four other Nordic countries. This is an expansion from a similar concept that has been hugely successful in Silicon Valley. Within the project, the Finnish Consulate will train selected companies and expose them to networks/speakers/mentors to develop their businesses.

Though the meeting seemed to be rather official and presented us the possibilities for Finnish companies provided by the FC, the representatives were not ready-to-talk about their plans and the reasons why they do not have many customers and especially why they do not advertize their services within larger Finnish events, such as Slush.

Google

Monday continued with a visit to Google NYC. Luckily, the following visit had less formal format compared to the Finnish Consulate meeting. Indeed, the representatives, **Johanna Wahlroos, Matti Leppänen** and **Phil,** gave us a guided tour along a few Google premises, talked about the Google corporate culture, and emphasized the number of employees (~7 000 ppl). Unfortunately, we could see only ca. 50 of them. This is probably the consequence of their corporate culture – do not expose strangers to our ideas, or so it seemed...

Anyways, these people are trained well to inspire visitors and show that Google is the best place to work in. The mission of Google is "to help people to develop and live a happy life".

Another thing that sounds to be extremely helpful and a must-apply in other companies is the weekly event "TGIF". TGIF (Thank God It´s Friday) is an hour-long "meeting" (nowadays held every Thursday due to the global time zone challenges) where each Google worker can ask the founders any question related to the company in live online stream broadcast or via pre-submitted form.

The depiction of the work culture in Google fascinated us. For example, every Google employee has their own targets and deadlines written down and accessible for everyone through the company intranet. Our hosts also mentioned about the process how Google's products are being tested internally. All new product releases or major updates can be tested first internally by virtually anyone in the company to get the maximum feedback before releasing anything to public audience.

Idean

The company for the last visit on Monday was Idean. Idean is a startup founded in Helsinki in 1999 that later successfully expanded into the US. They started from a small windowless office in Palo Alto in CA but later moved into bigger offices on several locations in the US, such as their current office in NYC.

Idean is a global design company focusing on building brand perception for the world's leading brands such as Apple, IBM, Volkswagen, Samsung, John Deere, Sony and many others less known. Their customer and project portfolio seemed really impressive having worked with so many global big names. The New York office is the working place for ca. 10 employees though Idean frequently employs freelancers to contribute to their projects into two of the three departments: design and development.

Despite of the fact that Idean had been isolated inside Finland since 1992 to 2012, it had undergone the expansion to the US market first and only then to

the European market last year. Furthermore, in 2012, Idean had only 5% of the revenue coming from the US, but it had risen up to 70% in 2015. We found this intriguing.

Tuesday, January 31st, 2017

Startup Health

We were warmly greeted in the lobby of a tall building on 85 Broad Street, where the elevator took us to 29th floor to the office of Startup Health. Startup Health, along with some other startups and companies share a common area on the floor. As always, the office spaces are made as comfortable as possible to accommodate the needs of every worker and make people willing to be there. Perhaps, this is one of the reasons there is a beer tap in the dining area. The office of Startup Health is conveniently located among other health startups in the same area, which makes it easy to collaborate with those companies, build networks and much more.

Startup Health launched in 2011, they are trying to create an ecosystem, a global "army" of health startups all on one mission to improve the health and wellbeing of everyone in the world. Startup Health identifies, engages and mobilizes committed stakeholders and individual investors to participate in the ecosystem. They provide a direct channel of communication between investors and entrepreneurs ready to improve and rebuilt healthcare. Additionally, they provide coaching and open up insights for companies who participate in their program.

The whole program is designed to be collaborative, aiming to create an ecosystem to help everyone to grow. The program includes coaching sessions with 4–5 companies at the same time, where they share their experiences, growth stories, etc. Startup Health is all about lifetime commitment to their relationships with the participating companies. While there are other typical business incubators and accelerators who provide short term programs of about 2–3 months, Startup Health is more like a grad school for startups. They say that, in the business where sale cycles can be up to 18 months, quick 90 days is just not sufficient to grow a company in the sector.

One of the main important feature for companies to participate is the right mindset, they have to be "batteries included" – ready to work for the future mutual goal. Ideally, they would like to compress 100 years of progress in just 25 years of work and they have a strategy for this. They would like participating companies to add more energy into the movement to overcome the obstacles together, believing that if they engage the best minds to work together, it is

possible to cure cancer, malaria, etc. At the moment they have 10 large active projects called "Moonshots" in diverse directions of healthcare, including such Moonshots as curing cancer, improving mental health, longevity – adding 50 years to human's life, ensuring everyone has access to high quality nutrition and others.

Companies doesn't have to be based in the US, in fact, about 20% of their portfolio is situated outside of the US. At the moment, Startup Health have expanded to Helsinki and Colorado, aiming to build a healthcare hub around these connections and to continue the expansion. In Finland, the network is collaborating with an investing agency of Finland – FinPro, which attracts foreign investments to improve entrepreneurship in healthcare. They are committed to find best entrepreneurs for digital health, leveraging on the surplus of talent after Nokia's downfall.

Sean Doolan giving the class of BitBang 9 a presentation about Startup Health

Urban Future Lab

The Urban Future Lab (UFL) is New York City's hub for smart cities, smart grid and clean energy. The hub hosts three programs focused on the issues of sustainability. The three programs are: ACRE – the New York City's premier cleantech incubator, PowerBridgeNY – proof-of-concept center that finds promising energy cleantech companies from research labs and invests in the transition of these technologies into the market, aiming customer orientation and scalability, Cleanstart- a professional training program for students to start

a career in cleantech. The minimum requirements for a team to be accepted in the hub is a proof of concept which should be backed up by 100 customer validation interviews.

ACRE smart cities incubator supports early stage businesses with innovative technologies and new business models. ACRE has an extensive community of cleantech industry stakeholders, where members can benefit from networking inside the community or getting other types of support, such as access to financial, accounting, legal, sales, marketing and design services. For the ACRE incubator the minimum requirements for admission are a product and some sales. After admission, the focus is on piloting and commercialization.

PowerBridgeNY invests in promising early stage cleantech companies to develop a commercial prototype and make first tests on the market. In addition, supported by NYSERDA, the center provides services and training for teams to discover the best business model and help them establish a startup in New York city.

NYU Clean Start Diploma program provides students with skills required for careers in cleantech. Upon completion the learning objectives of the program students will gain a practical knowledge of real-world simulations, project scenarios and case studies.

During our visit, besides the presentation of the Urban Future Lab, we were lucky to receive a speech from a representative of Confederation of Danish Industry, Klaus Lehn Christensen, who have presence in New York and Shanghai as Denmark's Cleantech Hub. They have a stance in the premises of Urban Future Labs, promoting cleantech solutions from Denmark and helping Danish small and medium-sized companies to establish a business in New York.

Erkki Ormala - Aalto University, Joe Silver - Urban Future Lab/ACRE, Klaus Lehn Christensen - Confederation of Danish Industry, Danish Cleantech Hub

Wednesday, February 1st, 2017

Nokia Bell Labs

Nokia Bell labs is an outstanding research institution with a long history in innovative technological research across various fields. Since its founding in 1871, the researchers at Nokia Bell Labs have made several vital contributions to the world such as the transistor, C language, solar cells, true sound motion picture technology and also evidence validating the Big Bang Theory. These technologies which are now ubiquitous in our lives have garnered Bell Labs 8 Nobel prizes altogether. In a very nice talk, Mr. Peter Vetter who heads Fixed Access Lab, introduced Nokia Bell Labs to us and all that it stood for.

The essence and focus of the research at Nokia Bells Labs is in 'creating time by expanding the human possibilities of technology'. This philosophy propels innovations and devices that enable faster, effective and efficient work. A prime example of this would be the invention of transistor to which the digitalized world owes its whole existence. Their current research is led by ambitious goals that require a ten-fold: 10X improvement over the present market technology. This is their key performance indicator (KPI) which propels products to be disruptive game-changers, something which Bell Labs is not new to. Presently Nokia Bell Labs employs over 1000 researchers world-wide across 7-10 strategic research domains focusing mainly on networks and communication and working in close collaboration. They have also diversified their operations through consulting to help implement new technologies in the market. They also engage actively in projects with universities.

To foster innovative and entrepreneurial mindsets, Nokia Bell Labs have spaces called "Le Garage" where their engineers work on new ideas or projects which do not immediately fit the institution's mainstream work. These ideas may later be reabsorbed or formally launched as a startup or spin-off. They have also published their views on the future of technology in the book "The future X Network: Building the digital fabric for the automation of everything and the creation of time". Herein they claim artificial intelligence driven automation as the next technological revolution; which however requires improvements in data transmission and the quality of service. So gigabit communication and virtualization is the focus of their future work, but still centered on human needs. This was also evident in their vision showcased to us at 'Anomaly': a fused interaction paradigm where time, devices, people, places, communication channels all converge. Although it is an existing theme combining augmented intelligence

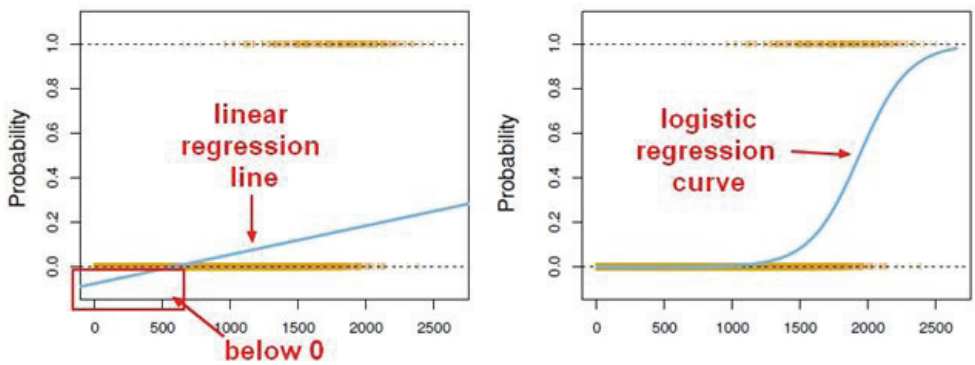
with internet of things, it was nevertheless quite cool to witness. On the whole, it was a truly motivating experience to be at Nokia Bell Labs. It was humbling and overwhelming to be in the halls of the legends of the modern technological revolution. The path breaking work they have been doing and continue to do, and the passion underlying it all left a big impact.

Thursday, February 2nd, 2017

IBM augmented intelligence workshop

In 1950, Alan Turing developed the Turing test (if you don't know the father of modern computer science, please at least watch the movie "The Imitation Game"). The Turing test let's a person text-chat with two individuals: a real person and a machine; and then the first person has to decide who the machine is and who the real person is. The IBM Watson Health workshop started with the same question: "Are you talking to a person or a machine?" Watson is augmented intelligence which purpose is to help people in their work but not steal it from them. For a physician, for example, it is a second opinion but not a substitute, or this we were told. The presenter also confirmed that mainly 3 capabilities differentiate Watson from other similar products: understanding, reasoning and learning.

We were them taught the principals of machine learning. A computer is a deterministic system, we have an input, some processing and we are provided an output. One of the simplest example of processing is a linear regression where we classify our input into a "yes" or a "no", "dog" or "cat", "person" or "no person", etc. Watson works with logistical regression, also called "s-curve" (see figure).



Example of linear and logistic regression.

The presenter then showed on a white board how a neural network can be trained. After the presentation we were encouraged to try Watson by ourselves, which we did. We saw how easy it is to use the framework provided from IBM in order to build a chatbot or a smart system that would filter Airbnb reviews based on our preference. We did not really have the time to see full potential of Watson and we never felt that we are talking to a real person, but fortunately it is something that we can do at our homes because the workshops are very well documented. I recommend anyone to try the face recognition workshop because it took me 30 minutes to build it and few things can go wrong, it is the easiest workshop and one of the most entertaining.

Friday, February 3rd, 2017

MIT Museum

We started our day by visiting the MIT museum. Founded in 1971, the museum has a collection of science, technology, and other areas of scholarship. Their mission is to best serve the nation and the world in the 21st century by collecting and preserving objects that are significant in the life of MIT; creating exhibits and programs that are firmly rooted in MIT's areas of endeavour; and engaging MIT faculty, staff, and students with the wider community. The museum provides various workshops that visitors can enroll. Unfortunately our schedule did not allow us to join one.

Luckily there were multiple exhibitions we could enjoy. The most engaging one was the holography exhibition "Dimensions of Light" that showed how the interplay between one's eyes, brain, and light creates three-dimensional space. By viewing the various optical components used in making holograms, one began to understand the physics that make these dramatic images possible. Another exhibition that stuck to our minds was the one called "Projects and Prototypes" that was a collection of MIT student work. MIT undergraduate and graduate students can propose their project works made in class in the current academic year to be on display at the museum. There were also exhibitions on photography, kinetic art, urban architecture, robots and nautical engineering, so everyone surely found something in their liking from the MIT Museum.

Beaver Works

During our visit to the MIT Lincoln Laboratory Beaver Works Center we were given a presentation about structure and activities of the organisation. It is a

federally funded research and development center on a mission to provide and improve technology and support for national security in the US. Among key roles of Beaver Works is the system architecture engineering, long-term technology development and system prototyping. The cooperation between MIT and Lincoln Labs is a military-academia project, as you have to be a citizen of the US with security clearance to join. Having about 3954 employees and large funding of about $925M, Beaver Works focuses on such areas as Air and Missile Defense, Homeland Protection, Air Traffic Control, Communication Systems, Cyber Security, Space Control and other military systems and technologies.

Lincoln Labs promote a new generation of students to opportunities in engineering and research. They are hosting nation wide camps for young students who would like to expand their knowledge in engineering and science. During these camps students learn about teamwork, expand their knowledge in engineering and robotics. One example of such is the competition, where students create their own autonomous cars and later compete with other teams, making advanced education both fun and progressive.

We found out that the name Beaver comes from the MIT's mascot, which is also called Tim (MIT spelled backwards). The reason behind MIT having a beaver as its mascot is that the beaver is considered to be nature's best engineer.

Bengt Holmström (MIT)

Speaking to us in the MIT Sloan School of Management, the Nobel laureate in economic sciences 2016 Prof. Bengt Holmström opened up to us in a candid talk on the differences between the Finnish and US university education systems. He remarked how the common complaint in favour of the budget cuts at Aalto University was that the students were too many; and how he always felt strongly to the contrary. Nevertheless he admitted that the stagnant pool of passive students who do not graduate puts pressure on the system. In his opinion, this is due to a lack of competition in the Finnish university education system.

Prof. Holmström insisted that at the university level, students benefit from being competitive and that the system should encourage this. He felt that the practice of offering multiple exam chances to Aalto students dampened their drive resulting in delayed graduations. Such issues are not immediately obvious in the Finnish context due to cultural reasons. Finland's school education system which is considered the best in the world is very inclusive of all students and this continues at the university level also. In contrast, reminiscing on his time at Stanford, Prof. Holmström remarked on how aghast he was at the ease with which his peers were discussing each other's test grades and performance.

Prof. Holmström explained that at MIT, the undergraduate students are the most vital target group and not the Master's or Doctoral students as might be expected. Every undergraduate is assigned a professor who advises him/her in all matters curriculum-related and otherwise and it is crucial for them to be in contact quite frequently. He recalled an Aalto undergrad who had not once in his three years of study met with his study advisor. In MIT, Prof. Holmström insisted that the onus of establishing and maintaining contact with the student rests with the professor. He recounted an instance right after he was awarded the Nobel Prize where he cut an interview short to attend to a student who had showed up at his office. It was also surprising to learn that to graduate from the MIT doctoral program, while one needs to demonstrate a certain degree of prowess in their field, there are no stipulations on publishing.

Prof. Holmström was very encouraging of us and very inspirational too. His intensity and passion for teaching as well as his love for his students was shining through his whole talk. It was very motivational to be in his presence, and he made us feel like each and every one of us counted.

Aalto University

This book is the 9th in the Bit Bang series of books produced as multidisciplinary teamwork exercises by doctoral students participating in the course **Bit Bang 9: Entrepreneurship** at Aalto University during the academic year 2016–2017.

Working in teams, the students set out to answer questions related to entrepreneurship and to brainstorm radical scenarios of what the future could hold. This joint publication contains articles produced as teamwork assignments for the course.

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